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ABSTRACT

This document, the second of three related reports, constitutes the data collection and analysis section of the study designed to provide information for preparing a planning guide for drafting and design technology programs. The curriculum survey instrument mailed to 26 schools, contained questions regarding: (1) length of semesters, (2) enrollment data, (3) disposition of program graduates, (4) general curriculum structure, (5) selection of specialty courses, and (6) course content. The facilities survey instrument was returned from 25 program directors and 38 instructors. This was followed with a visitation to each school by the researcher. Items that were considered include: (1) location of drafting rooms, (2) flexibility and width of aisles, (3) air conditioning and ventilation, (4) electrical outlets, (5) ceiling heights, (6) illumination, (7) floor areas, (8) compressed air, (9) drafting machines, (10) storage facilities, (11) audiovisual aids, and (12) office facilities and equipment. The industrial survey instrument was returned from 375 industrial concerns. The instrument consisted of a battery of information forms designed for rating by area specialists. The size of the concern and job training needs were considered. The developmental procedure and planning guide and the appendixes are available as VT 014 407 and VT 014 408 respectively. (GEB)

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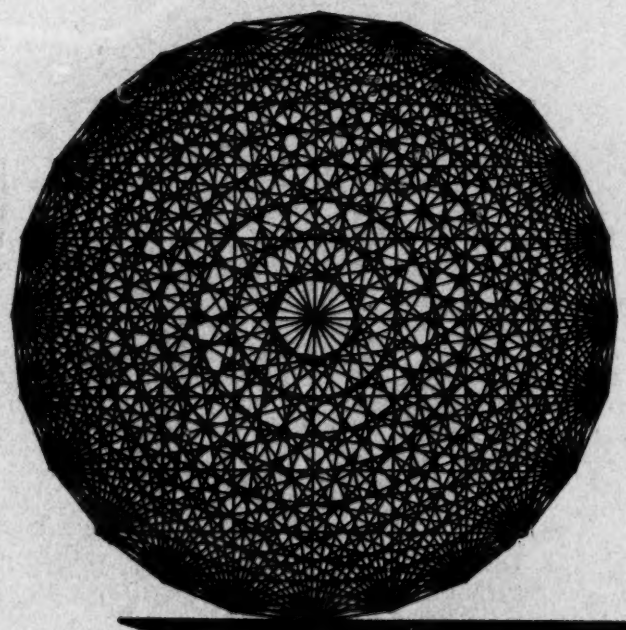
III

A GUIDE FOR PLANNING



Drafting and Design Technology Programs

1971

Prepared For

Division of Occupational Research and Development

Texas Education Agency

Austin, Texas 78701

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SECTION III

DATA COLLECTION AND ANALYSIS

SECTION III

DATA COLLECTION & ANALYSIS

A. The Curriculum Survey

Research Procedure

The curriculum survey was planned to collect information about the course content and curriculum structure in existing (1968-1969) programs of Drafting and Design Technology (D & DT) in state-supported junior colleges in Texas. Data were obtained from questionnaires completed by drafting department personnel in the junior colleges, and from the colleges' course catalogues.

Preliminary steps.--At the time the research was being considered, a visit was made to the Post-Secondary Vocational Education Program Development Division of the Texas Education Agency in Austin, Texas. Conversations with personnel of that office revealed a need for curriculum information on the Drafting and Design Technology programs then being offered in the state-supported junior colleges in Texas.

As a result of these conversations, a proposal to undertake the research was submitted to the Texas Education Agency and was

subsequently approved for funding by the research coordinating staff of that agency. Letters were also sent to appropriate education agencies in other states requesting samples or sources of information concerning similar studies which may have been conducted in those states. (See Appendix A for sample letter.)

Preparation of the questionnaire.--In an attempt to obtain a consolidated view of D & DT curricula being offered throughout the state, it was decided to compile a questionnaire which would be reasonably consistent in form, yet flexible enough so that each school could complete it according to its own particular D & DT curriculum. To accomplish this, an intensive examination of each school's D & DT curriculum was made from its catalogue of course offerings. From this examination, the various types of drafting courses were classified under general, numerically coded titles. Using a common questionnaire form, each school received a questionnaire which was "customized" to its particular course offerings, by having its own course names and numbers indicated on a form which was numerically coded under one of the course classifications selected by the researcher. Each coded form contained a listing of topics selected from catalogue course descriptions, consultations with other instructors, and personal background

knowledge of the researcher. Space was provided for each respondent to add topics which had been omitted from the forms.

To assess the weighting that each topic receives as a course is taught, a relative importance scale was included, on which the respondent was to indicate his assessment of the importance of each topic to the overall course structure, based upon time spent on that topic during the course. The assumption was made that time devoted to each topic is a measure of its importance relative to other topics in the course structure. Other information requested for each course was the proportion spent on lecture (theory) and laboratory (practice) for each topic, and an estimate of the importance (less, equal or more) of the topic five years in the future. The number of weekly clock hours devoted to each course, and the credits given for it were also requested.

The relative importance scale for each topic ranged from zero to ten, with a zero response to indicate that the topic is not included in the course, and a response of ten to indicate that the topic receives maximum emphasis, i.e., no other topic receives more emphasis. There could be more than one response of ten in any one course topic listing.

Preliminary pages in each questionnaire requested information concerning the annual semester schedule dates for each school,

enrollment figures, student-instructor ratios, and estimates on the disposition (employment or otherwise) of D & DT program graduates. A typical questionnaire page was completed for a hypothetical case as an example, with explanatory notes. (See Appendix A for sample questionnaire.)

Selection of participating schools.--The Directory of Post-Secondary Vocational-Technical Programs in Texas, 1968-69, was consulted to compile a list of state-supported junior colleges offering D & DT programs. From this list, a file of twenty-nine school addresses was established (Table 13), and correspondence began with the key drafting personnel at each school. The initial letter briefly outlined the proposed research and invited the correspondents' participation in the study. A copy of each school's course catalogue was also requested at this time. The departments contacted were sent a follow-up letter if no response had been received after five weeks. Included in the follow-up letter was a stamped, self-addressed postcard on which the correspondent needed only to check a box indicating his willingness to participate. (See Appendix A for sample letters.) Approximately two months after initial letters had been sent, the list of participants was finalized, consisting of twenty-six of the original list of twenty-nine schools.

TABLE 13

JUNIOR COLLEGES IN TEXAS OFFERING DRAFTING AND DESIGN TECHNOLOGY

College	Location
* Alvin Junior College	Alvin
* Amarillo College	Amarillo
Angelina College	Lufkin
* Bee County College	Beeville
* Brazosport Junior College	Freeport
* Central Texas College	Killeen
Cisco Junior College	Cisco
College of the Mainland	Texas City
* Cooke County Junior College	Gainsville
* Dallas County - El Centro	Dallas
* Del Mar College	Corpus Christi
Galveston County College	Galveston
* Grayson County College	Sherman-Denison
Henderson County Junior College	Athens
* Hill Junior College	Hillsboro
* Howard County Junior College	Big Spring
* James Connally Technical Institute	Waco
* Kilgore College	Kilgore
* Lee College	Baytown
* Navarro Junior College	Corsicana
Odessa College	Odessa
* San Antonio College	San Antonio
San Antonio - St. Philip's College	San Antonio
* San Jacinto College	Pasadena
South Plains College	Levelland
* Tarrant County - South Campus	Fort Worth
* Temple Junior College	Temple
* Texarkana College	Texarkana
Tyler Junior College	Tyler
* Wharton Junior College	Wharton

* Reasearch participants

One school declined to participate, the reason given being that they were fully occupied with other pressing matters at that time; one school failed to respond to any correspondence; and one school was subsequently discovered to have no formal D & DT curriculum, and was not asked to participate. The geographical distribution of participating schools is shown in Figure 3.

Pilot study.--Preliminary, partial questionnaire forms were compiled and sent to three of the participating schools[1] with an invitation to contribute criticisms and suggestions concerning the appropriateness, clarity and understanding of the form proposed. (See Appendix A for sample letters.) Responses from these indicated that no substantial changes would be required in the questionnaire forms. Final forms of the questionnaire were then compiled and sent to each of the twenty-six schools which had agreed to participate.

Response to the questionnaire.--Of the twenty-six questionnaires mailed, twenty-three were returned, one of which was returned blank. Having followed up and corrected minor discrepancies in returned questionnaires, a final data set of twenty-one

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[1]The schools in the pilot study were: Central Texas College, Killeen; Henderson County Junior College, Athens; and Kilgore College, Kilgore.

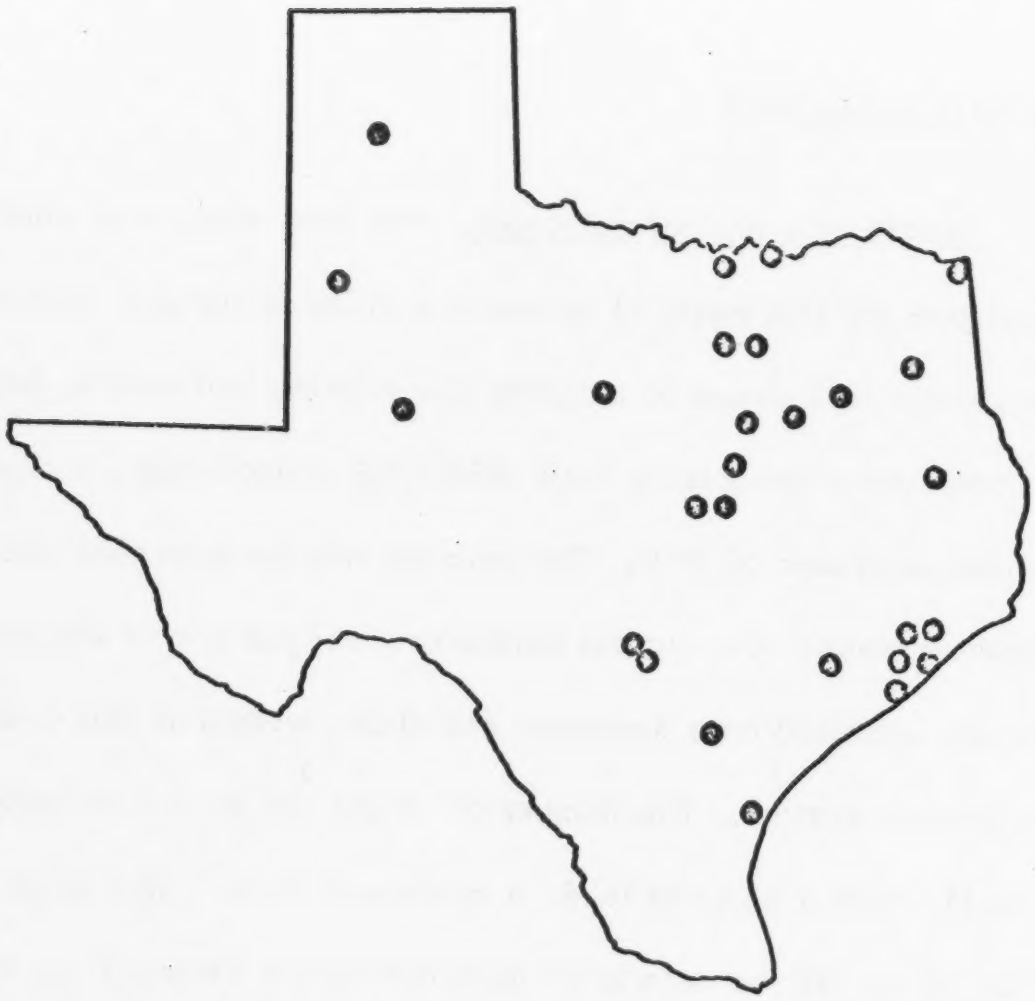


Fig. 3 --Geographical distribution of participating junior colleges

completed questionnaires was obtained, representing an eighty-one percent return of usable data from the original requests.

Analysis of the Data

Length of a typical semester.--The first section of each questionnaire (Appendix A) included a blank chart upon which each respondent was asked to indicate the starting and ending dates for the semesters comprising their 1968-1969 school year, including the summer sessions of 1969. The purpose was to determine the average length in weeks of a typical semester. All but one of the responding schools operated on a semester schedule, with that one operating on a trimester system. The number of weeks per semester ranged from 15 to 18, with a mean of 16.3, a median of 16.2, and a mode (15 out of 21) of 16. These data are illustrated in the histogram of Figure 4. The typical semester was therefore taken to be 16 weeks in length, and the suggested curricula outlined in this guide are arranged on that basis.

Enrollment data.--Also requested in the first section of the questionnaire were enrollment figures for each school, consisting of total school enrollment, vocational-technical enrollment and D&DT enrollment. Histograms summarizing these data are found in

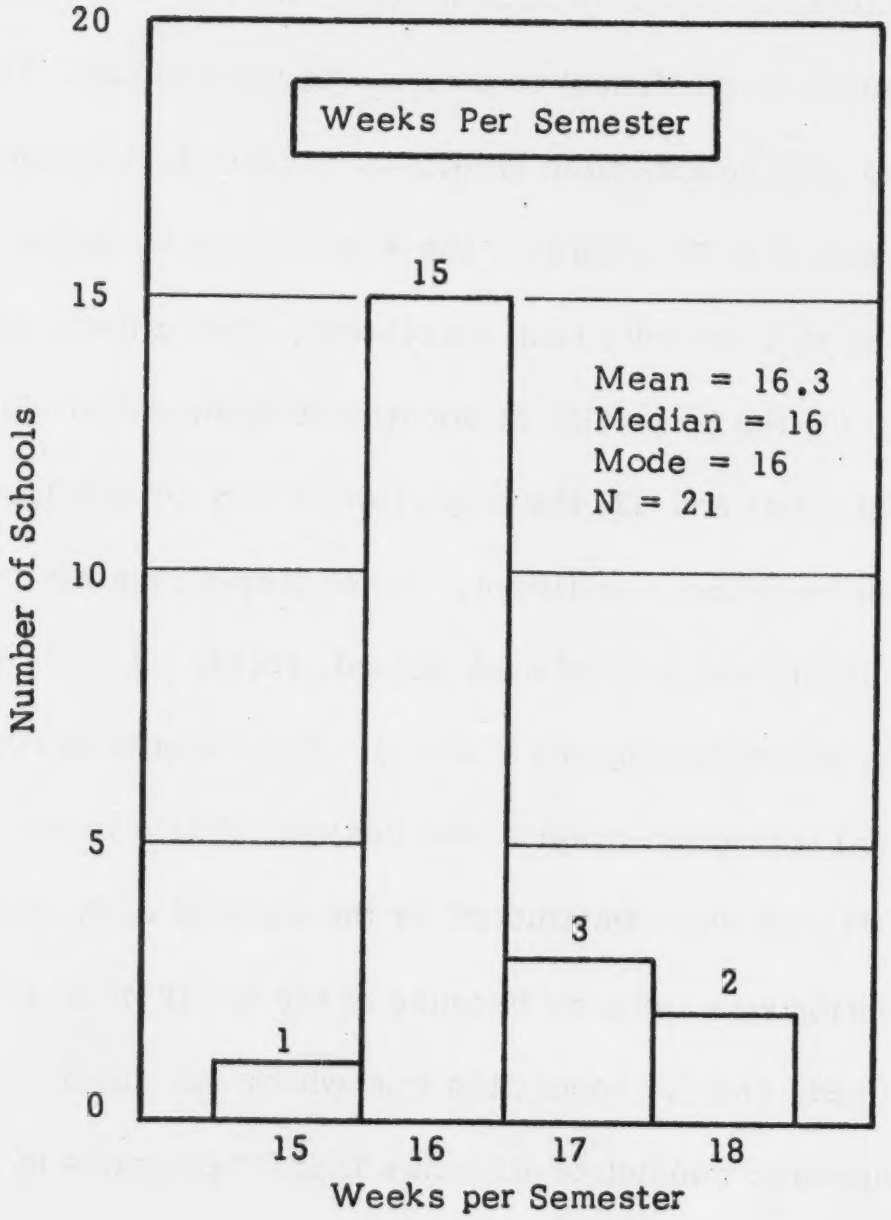


Fig. 4 --Number of weeks per semester

Figures 5, 6, and 7, respectively. Preliminary examination of these data revealed obvious skewness in their distributions and considerable variation in enrollment figures among the schools. These figures were to be used to establish prediction criteria for estimating enrollments in new D & DT programs; these criteria to be in the form of proportions of a school's total enrollment. Two criteria were selected; (1) the proportion of vocational-technical enrollment in total enrollment; and (2) the proportion of D & DT enrollment in vocational-technical enrollment. These proportions were obtained from the enrollment data of each school, (Table 14) and are displayed as scatter diagrams (Figures 8 and 9). Some degree of confidence in the final prediction criteria was desired, thus a ninety percent confidence interval was constructed for the mean of each proportion. A t-distribution was assumed because of the small (N less than 30) sample used, and the population from which the sample was drawn was assumed to consist of all future D & DT programs in Texas. It was further assumed that the existing programs comprised a representative sample of that population. As a further check upon the reliability of these criteria, the same data were tested by a linear regression analysis with the added provision of forcing the regression line through the origin. This provision was invoked because

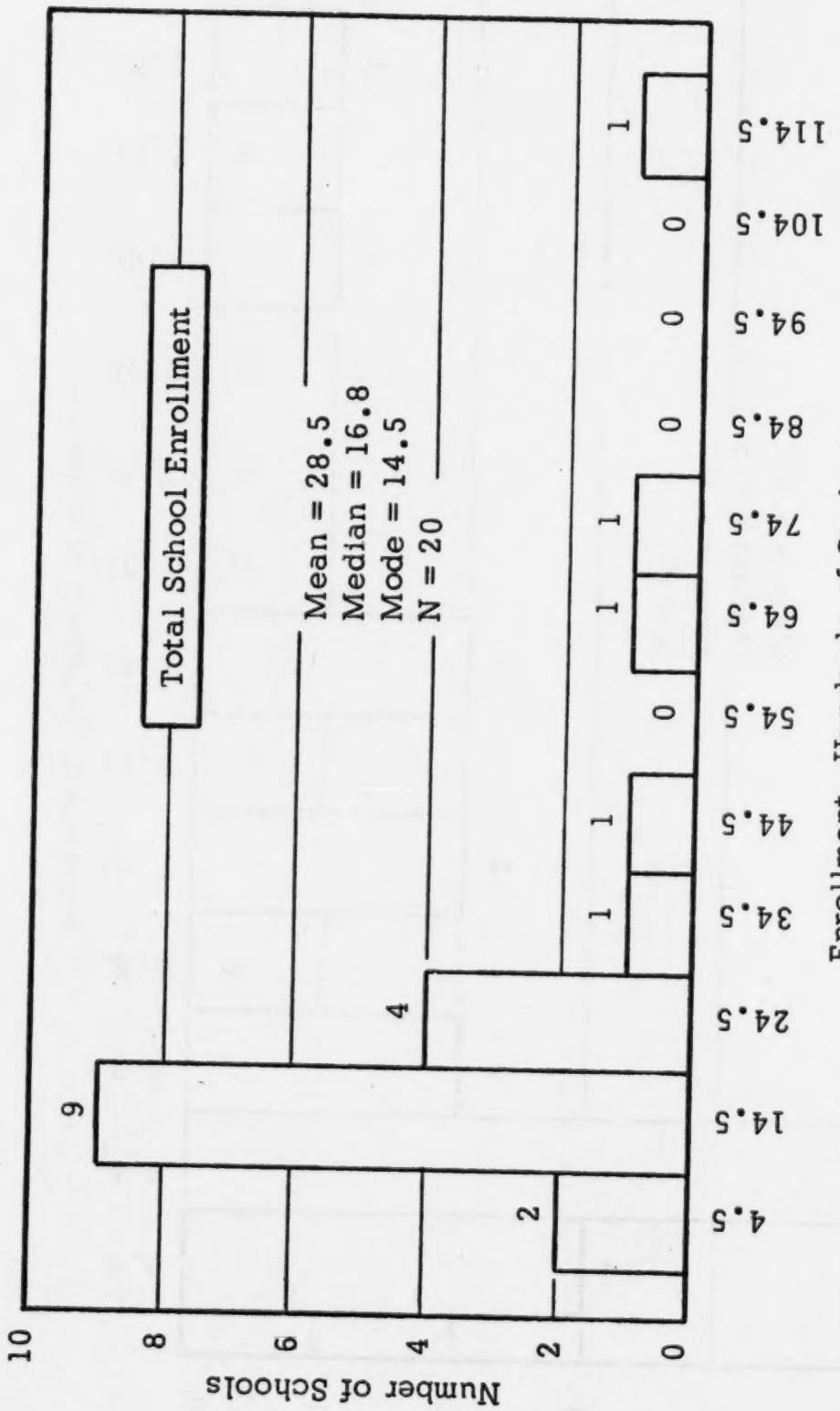


Fig. 5--Total School Enrollment

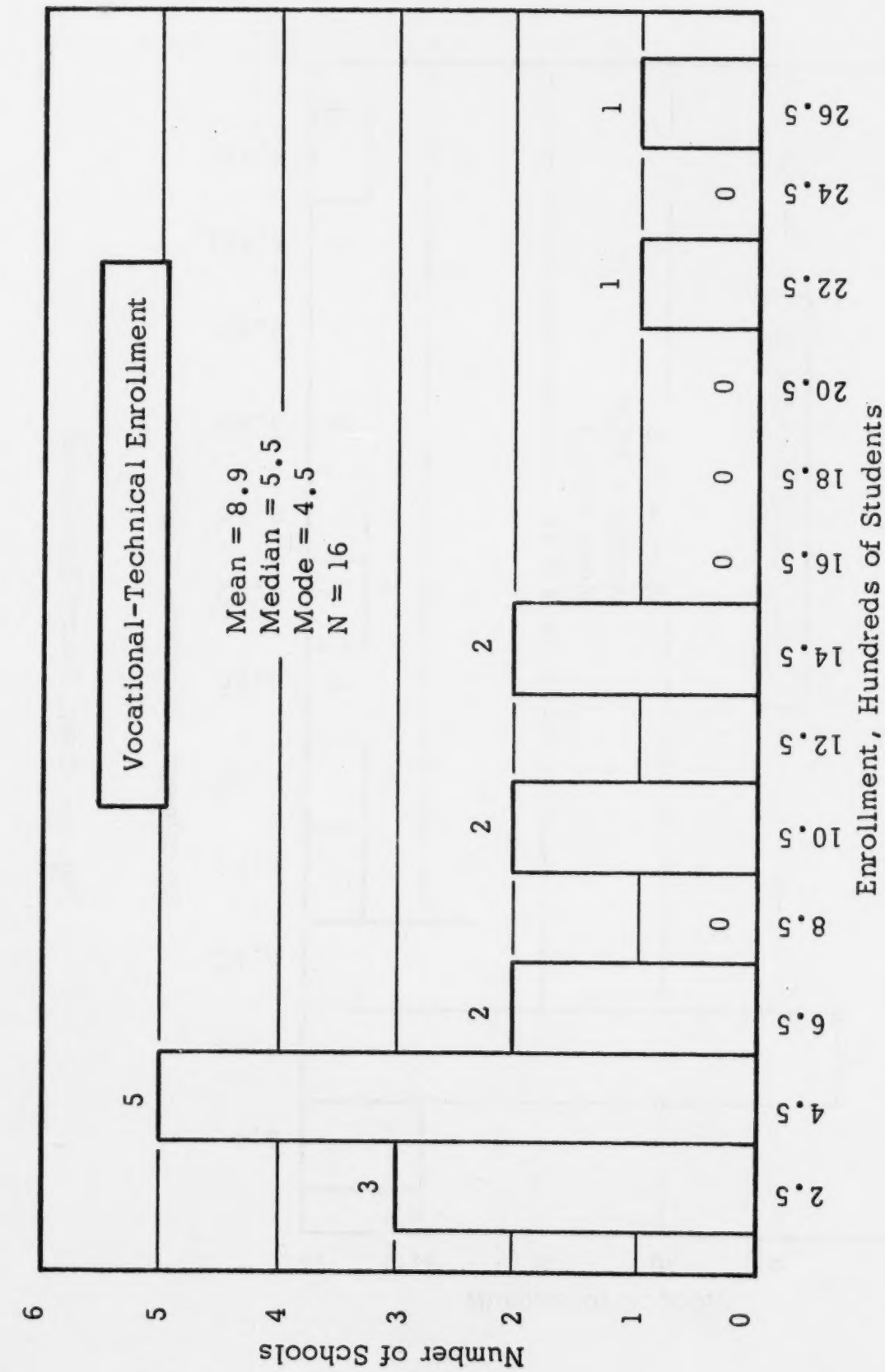


Fig. 6--Vocational-Technical Enrollment

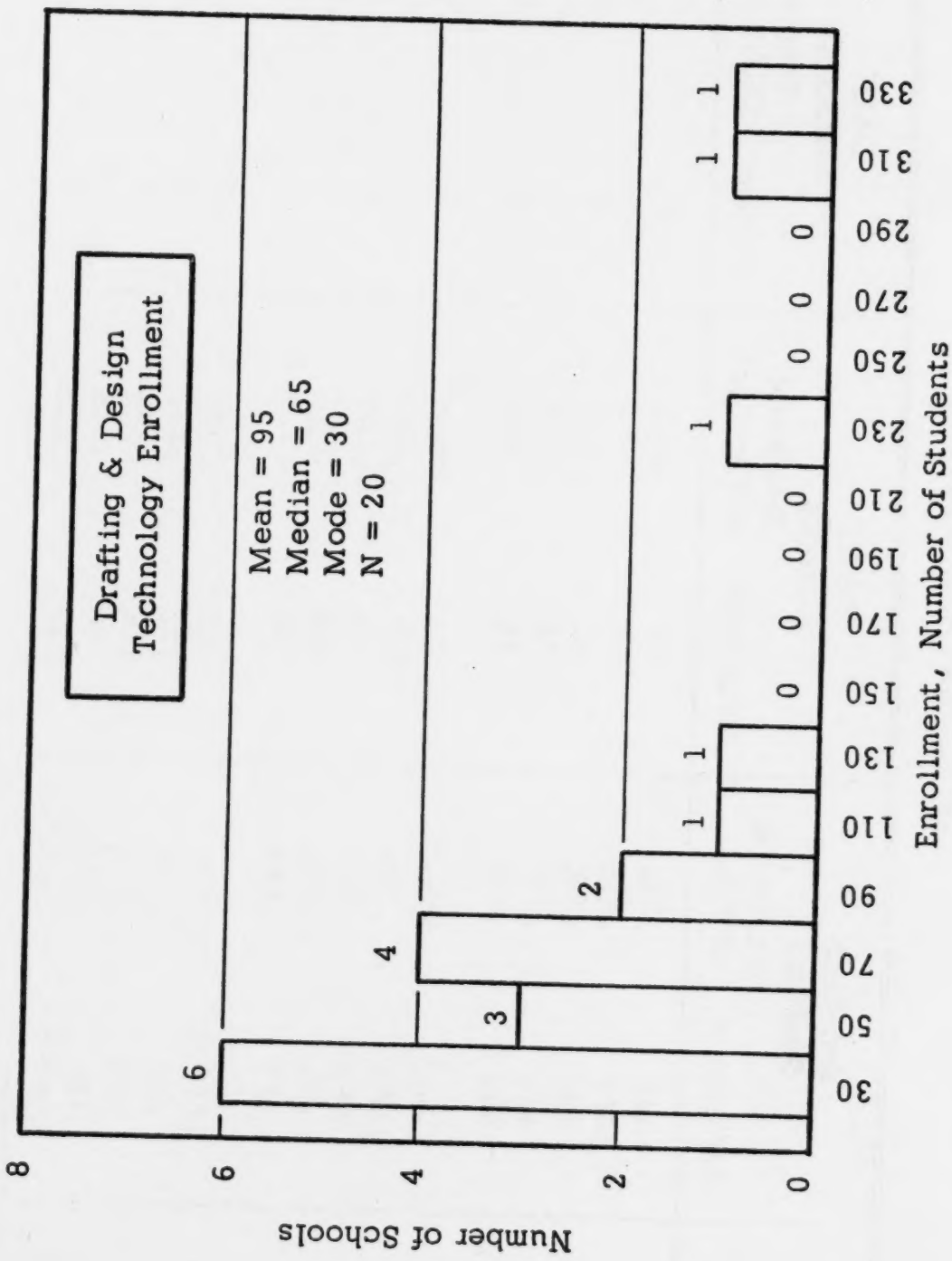


Fig. 7--D & DT Enrollment

TABLE 14

ENROLLMENT AND STAFFING

Total Enrollment	Voc-Tech Students		D&DT Students		D&DT Instructors	
	Enrollment	Proportion of Total	Enrollment	Proportion of Voc-Tech	Number	Proportion of D&DT Enrollment
1298	446	.346	89	.200	1	.011
3510	1445	.410	75	.052	2.5	.033
1000	300	.300	30	.100	2	.067
1092	421	.385	73	.173	1	.014
2000	450	.225	35	.078	1	.028
1325	****[1]	****[2]	75	****[2]	1	.013
7000	2300	.328	300	.130	3	.010
2000	660	.330	70	.106	3	.043
500	150	.300	25	.167	1	.040
1052	152	.143	41	.270	1	.024
1067[3]	1067[3]	1.000[3]	26	.024	6[3]	.231[3]
2267	425	.185	132	.310	5	.038
2838	600	.211	116	.193	2	.017
1149	358	.313	88	.246	1.5	.017
11800[3]	1006[3]	.086[3]	223	.222	3	.013

[1]These figures were not provided by respondents.
[2]These figures could not be determined as a consequence of note 1.
[3]These values were considered to be singular data values--see text.

TABLE 14--Continued

Total Enrollment	Voc-Tech Students Enrollment	Voc-Tech Students Proportion of Total	D&DT Students Enrollment	D&DT Students Proportion of Voc-Tech	D&DT Instructors Number	D&DT Instructors Proportion of D&DT Enrollment
6450	2600	.403	330	.127	4	.012
4200	1400	.333	50	.036	3	.060
875	****[1]	****[2]	20	****[2]	1	.050
1800	****[1]	****[2]	40	****[2]	1	.025
1900	****[1]	****[2]	34	****[2]	1	.029
Σx:	4.212		2.434		0.544	
Σx^2:	1.353		0.479		0.0209	
N:	14		16		19	
$\bar{x}$:	0.301		0.152		0.0286	

[1]These figures were not provided by respondents.
[2]These figures could not be determined as a consequence of note 1.
[3]These values were considered to be singular data values--see text.

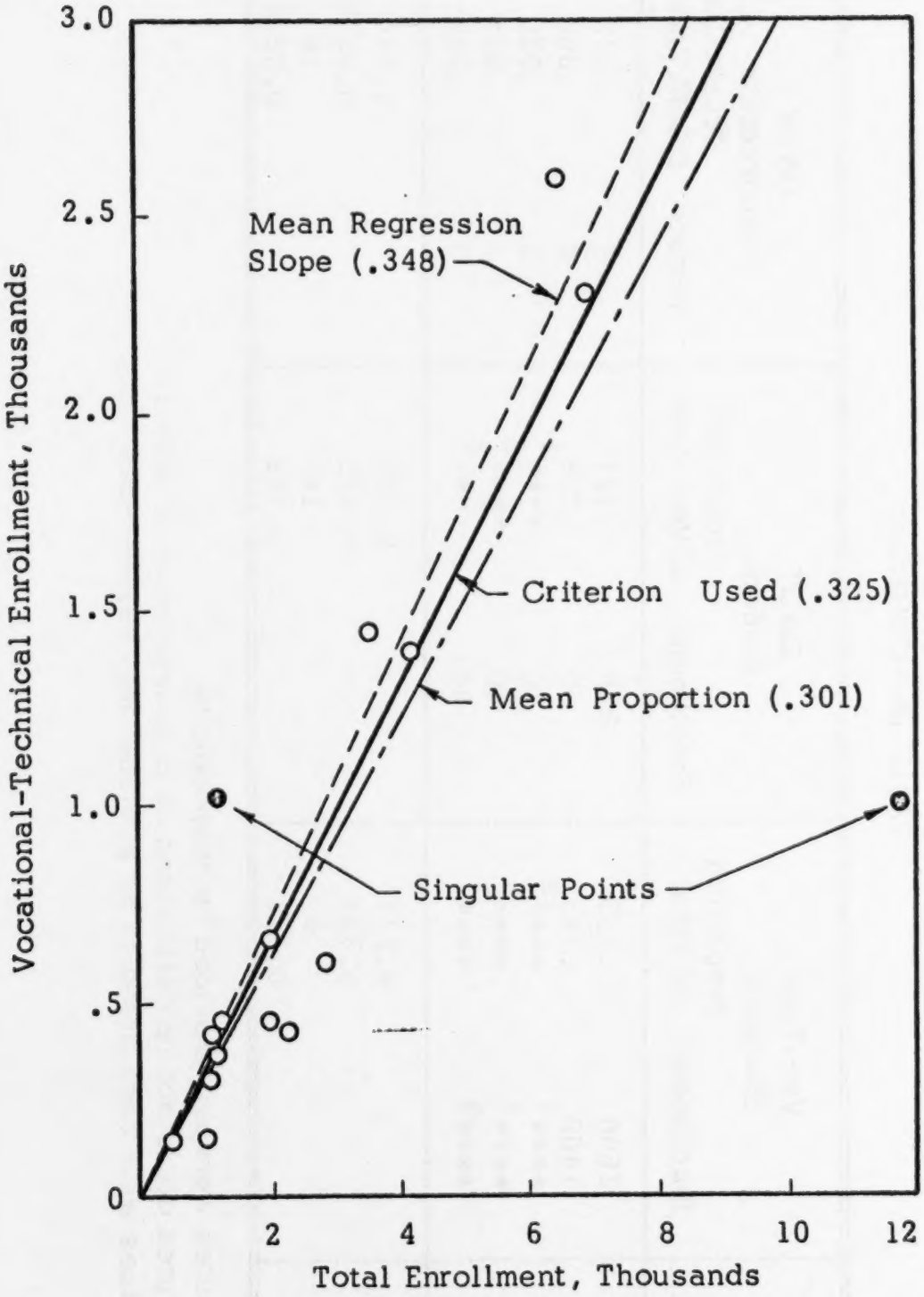


Fig. 8--Vocational-Technical Enrollment Ratio of Total Enrollment

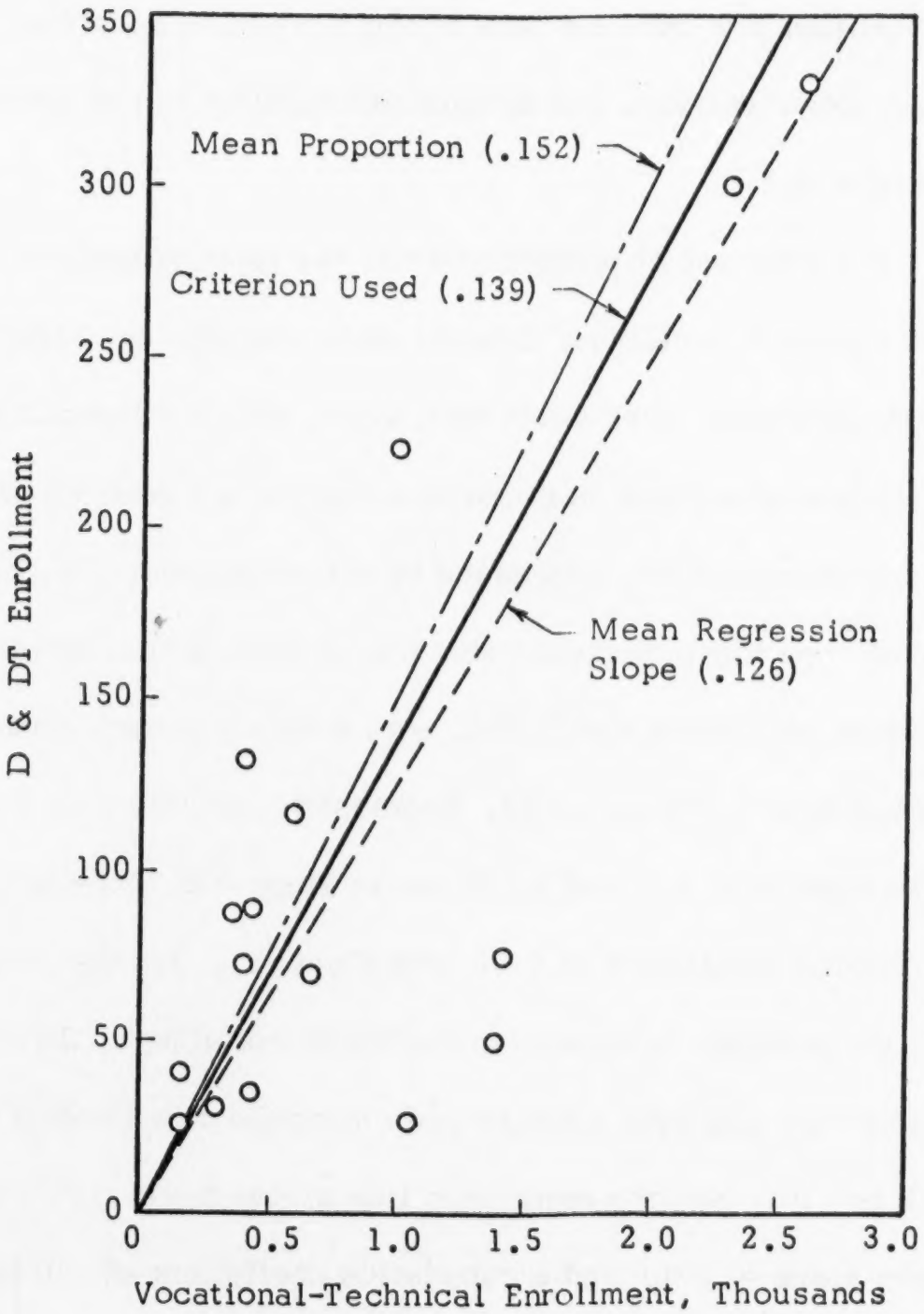


Fig. 9--D & DT Enrollment Ratio of
Vocational-Technical Enrollment

a clear proportion (slope of the regression line) was desired without the addition of a constant term to the regression equation. (Derivations, formulas used, and sample calculations can be found in Appendix A.)

For each set of proportion data, the mean proportion and its ninety percent confidence interval were compared with the slopes of the regression lines taken both ways, with the linear correlation coefficient of regression taken as an additional measure of the degree of relationship expressed by the proportion. For the proportion of vocational-technical students in total school enrollment, the mean proportion was 0.301, with a ninety percent confidence interval from 0.262 to 0.340. Regression analysis gave regression-line slopes of 0.342 and 0.353 (mean slope = 0.348) and a correlation coefficient of 0.98 (see Figure 8). For the proportion of D & DT students in vocational-technical enrollment, the mean proportion was .152 with a ninety percent confidence interval from .113 to .191, and the regression line slopes were .113 and .139 (mean slope = .126) and a correlation coefficient of .90 (see Figure 9). Isolated pairs of data were not included in the computations owing to their obvious singularity. In particular, one school was 100 percent vocational-technical, and its instructor/student

ratio was far greater than any other school. (These particular figures are indicated in Table 14, page 262.)

The above proportion intervals and regression line slopes were used as criteria for predicting enrollment, and are reflected in the enrollment prediction forms II-B-1, II-B-2 and II-B-3 found in Section II of this guide. The proportions suggested in those forms represent a compromise between the confidence intervals and the regression line slopes, and each is taken to be the mean of the mean ratio and the mean regression line slope. This resulted in a prediction ratio of .325 of total enrollment for vocational-technical enrollment and .139 of vocational-technical enrollment for D & DT enrollment (Figures 8 and 9). It is observed that both of these prediction ratios fall within their respective ninety percent confidence intervals. The actual calculations to be used in predicting enrollment vary among the three forms mentioned above, but the general scheme is as follows:

Let P_1 = proportion (.325) of vocational-technical enrollment in total enrollment

P_2 = proportion (.139) of D & DT enrollment in vocational-technical enrollment.

T_1 = non-technical enrollment

T_2 = non-drafting technical enrollment

T_3 = D & DT enrollment

T = total enrollment after adding D & DT program

Then $T = T_1 + T_2 + T_3$

From the above definitions, it can be seen that

$T_2 + T_3 = P_1 T$ and

$T_3 = P_2(T_2 + T_3)$

Examination of Forms II-B-1, II-B-2 and II-B-3 will reveal that each is designed to accomodate a different condition likely to exist at the start of the program-planning operation. These three conditions may be expressed as three cases for the application of the above formula: Case I, planning an entirely new school; Case II, adding to an existing school a vocational-technical program which is to include a D & DT program; and Case II, adding a D & DT program to an existing vocational-technical program. For each of these cases, different enrollment figures, T, T_1, T_2 and T_3 are known, and others need to be estimated, using the proportions P_1 and P_2.

Enrollment estimation calculations. For Case I, the total enrollment, T, is known (or assumed). The estimated vocational-technical enrollment, $T_2 + T_3$ is computed from the formula

$$T_2 + T_3 = P_1T = .325T$$

and the estimated D & DT enrollment is computed from the formula

$$T_3 = P_2(T_2 + T_3) = .139(T_2 + T_3)$$

For Case II, the existing non-technical enrollment, T_1 is known. The estimated vocational-technical enrollment, $T_2 + T_3$ is computed from the formula

$$T_2 + T_3 = \frac{P_1T_1}{1 - P_1} = .481\ T_1$$

and the estimated D & DT enrollment is computed from the formula

$$T_3 = P_2(T_2 + T_3) = .139(T_2 + T_3)$$

Total estimated enrollment T is given by

$$T = T_1 + T_2 + T_3$$

For the Case III, the existing non-technical enrollment, T_1 and the existing non-drafting technical enrollment, T_2 are known. The estimated D & DT enrollment is computed from the formula

$$T_3 = \frac{P_2T_2}{1 - P_2}, = .161T_2$$

and estimated total enrollment, T is given as before by

$$T = T_1 + T_2 + T_3$$

The above formulas were applied to the design of enrollment estimation forms II-B-1, II-B-2 and II-B-3, and are reflected in the procedures suggested therein.

Student/instructor ratio.--The first section of the questionnaire also requested each school to specify the number of regular full-time drafting instructors employed in the D & DT program. Preliminary examination of these figures revealed a wide variation in instructor/student ratios when the number of drafting instructors was compared to the D & DT enrollment in each school (see Table 14, page 262) Figure 10 is a scatter diagram of these data, and clearly shows this variation. As was done for enrollment estimation, a confidence interval, regression analysis was performed on the instructor/student ratios, and the results used to establish criteria for predicting drafting teacher requirements based upon D & DT enrollment estimation. For these data, the ninety percent confidence interval did not overlap the region defined by the two regression lines; the mean instructor/student ratio was .029 with a confidence interval from .022 to .036, whereas the two regression lines slopes were .016 and .021, with a correlation coefficient of .87. In this instance, the prediction criterion was taken to be the mean between the mean instructor/student ratio, .029 and the mean regression line slope, .018, resulting in an instructor/student prediction ratio of .024, which still falls within the ninety percent mean ratio confidence interval. This value is reflected in the staffing estimation form II-D-1 in Section II of this guide.

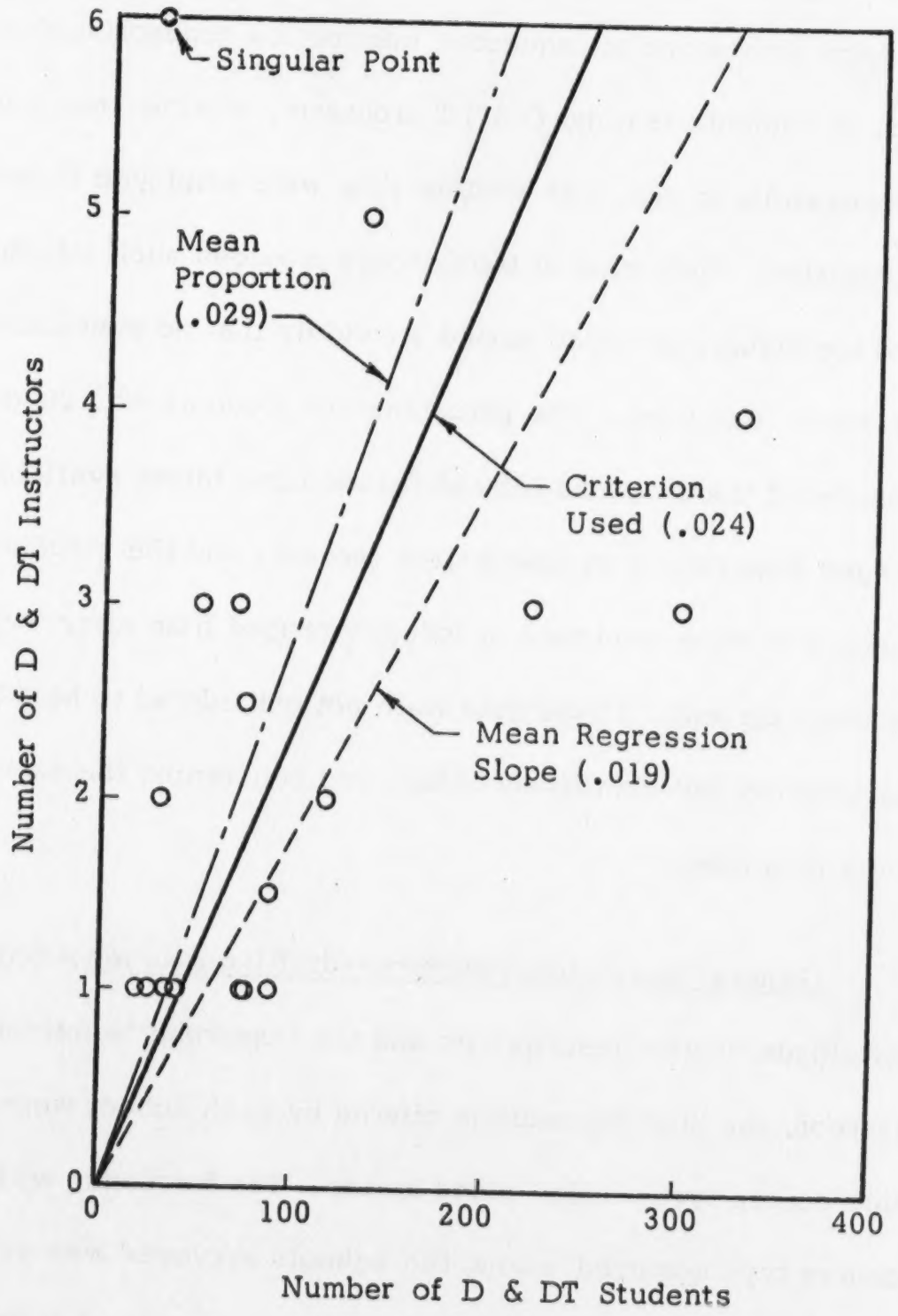


Fig. 10--D & DT Instructor/Student Ratio

Disposition of D & DT program graduates.--The second section of each questionnaire requested information concerning the disposition of students leaving D & DT programs, whether they completed successfully or not, and whether they were employed following graduation. Only nine of the schools provided such information, and the figures provided varied so widely that no conclusions could be drawn from them. The percentage of students who successfully completed the programs offered (based upon latest available figures) ranged from twenty to ninety-five percent, and the percentage of those who were employed in industry ranged from sixty-two to one hundred percent. These data were not considered to be adequate for drawing any significant inferences concerning the success of such programs.

General curriculum structure--drafting courses.--Based upon catalogue course descriptions and the researcher's interpretation thereof, the drafting courses offered by each school were classified into course types under coded names. The frequency with which a course type occurred among the schools surveyed was used as an initial criterion for establishing a suggested core of drafting courses to be offered in a D & DT program. The frequencies of occurrence are illustrated in Figure 11. The frequency groupings were arbitrarily

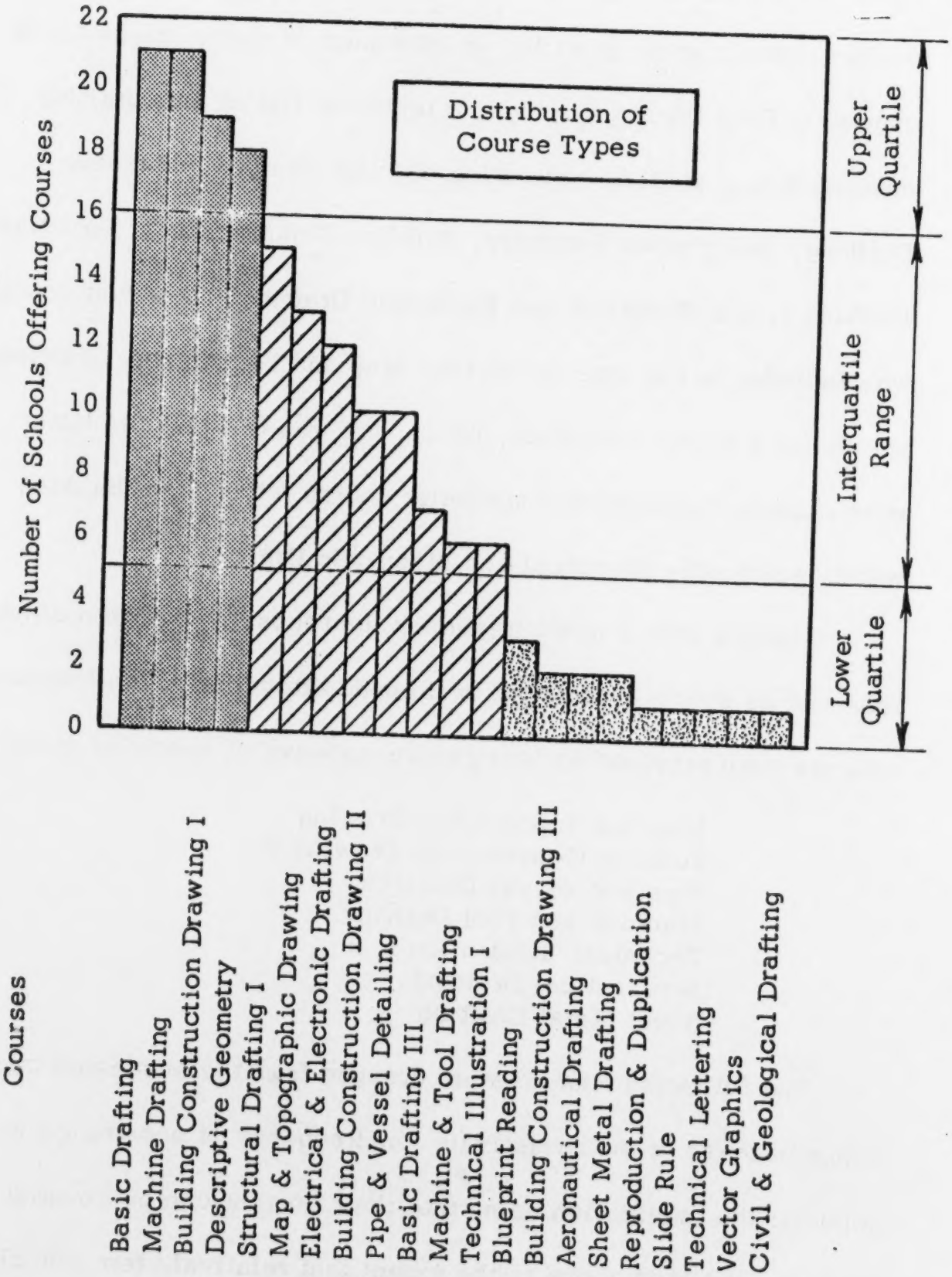


Fig. 11--Distribution of Drafting Course Types Among Schools Surveyed

divided into an upper quartile, an interquartile range, and a lower quartile. From these groupings, a tentative list of core drafting courses was compiled, consisting of Basic Drafting, Machine Drafting, Descriptive Geometry, Building Construction I, Structural Drafting I, and Electrical and Electronic Drafting. This last course was included in the core rather than Map and Topographic Drawing, which had a higher frequency, because it was felt that the latter more closely represented a specialty course rather than the more widely applicable Electrical and Electronic Drafting.

Courses with a lower frequency than those above were either reserved as specialty courses or dropped altogether. The following courses were reserved as being representative of specialty areas:

Map and Topographic Drawing
Building Construction Drawing II
Pipe and Vessel Detailing
Machine and Tool Drafting
Technical Illustration I
Aeronautical Drafting
Sheet Metal Drafting

The following courses were dropped from the suggested curriculum because of their relatively low frequency of occurrence in the schools; the implication being that their content can be covered in the courses listed above to the extent that relatively few schools considered them necessary:

Basic Drafting III
Blueprint Reading
Building Construction Drawing III
Reproduction and Duplication
Slide Rule
Technical Lettering
Vector Graphics
Civil and Geological Drafting

The scheme for the D & DT curriculum structure was to establish a basic core of courses which all D & DT students would take, and provide additional courses for training in a particular drafting specialty the student might elect. For this reason, the following courses were added to the curriculum to provide for those specialty areas not listed:

Structural Drafting II
Technical Illustration II
Pattern, Foundry and Forging Drawings

Two additional courses were designed to provide "enrichment" courses, suitable for any specialty area. These were:

Numerical Control Graphics
Graphical Analysis

Non-drafting courses.--Also based upon examination of school catalogues, five categories of non-drafting courses were established. They were:

Physical Sciences
Engineering and Related Courses
Communicative Arts
Social Sciences
Others not classified above

Further examination led to a separation of mathematics courses from the physical sciences, as a separate category. The mean proportions and numer of credit hours for each category of courses are illustrated in Figure 12. Ninety percent confidence intervals on the means are also indicated, and were used as criteria for establishing the number of credit hours suggested in the planning guide for courses in each category. (See Appendix A)

Selection of specialty courses.--On the assumption that students would select a specialty area on the basis of employment opportunities as well as personal inclination, the Dictionary of Occupational Titles was consulted to identify the types of drafting specialties recognized by industry. Based upon the draftsman job titles and descriptions found, the course types reserved earlier (page 275) were selected so as to conform as closely as possible to the kind of work described.

An industrial survey (part C of this section) established the geographical location of industries employing the types of draftsmen listed in the Dictionary of Occupational Titles. The proximity of a school to particular industries was then used as a means of determining the kinds of courses the school should consider offering in its D & DT curriculum so as to serve those industries with its

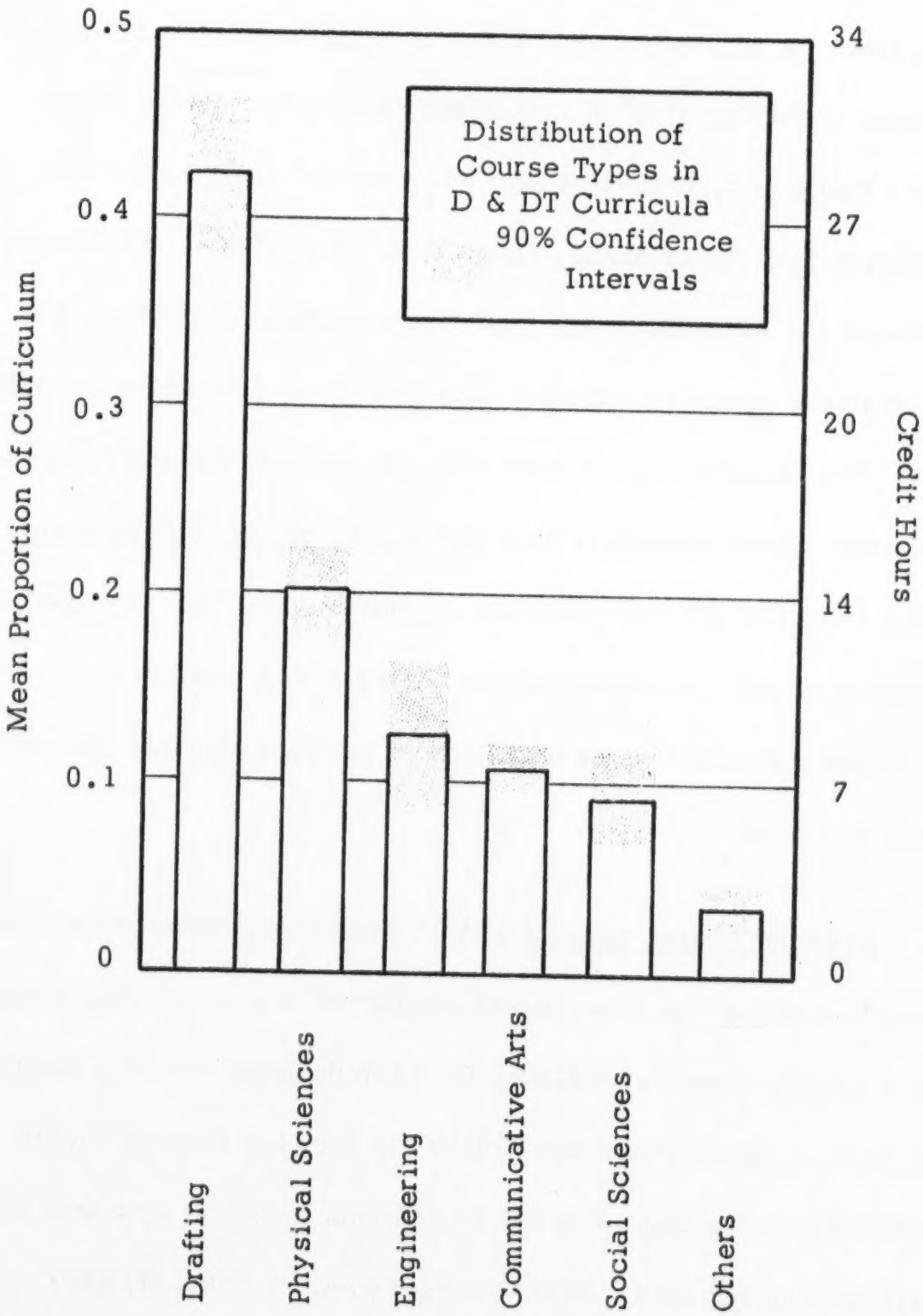


Fig. 12--Distribution of course types in D & DT curricula

graduates. It is this scheme which is reflected in the procedure outlined in Section II-C of this guide, and in the use of forms II-C-1 (page 30), II-C-2A (page 33), and II-C-2B (page 34). The suggested courses of study, forms II-C-4A to II-C-4L in Section II, represent the addition to the basic core courses of drafting and non-drafting specialty courses selected to support each specialty area. The selection of courses was not entirely arbitrary, but based upon both job descriptions from the Dictionary of Occupational Titles and upon job requirements as indicated by industry (part C of this section). No quantitative analysis was used in this selection, but rather a qualitative examination of job requirements and related areas was used.

Drafting course content.--With the general curriculum structure formed, perhaps the most important part of this curriculum study was to prepare topical outlines for each drafting course. Reference has been made earlier (page 250) to the common lists of topics included in each course in the questionnaire which was sent to participating schools. In responding to each item, drafting personnel were asked to rate each topic on a zero to ten scale, in which a rating of zero was intended to indicate that the topic was not taught at all; a rating of ten was to indicate that the topic received as much or more emphasis than any other topic listed under that course.

Thus, there should be at least one topic rated ten under each course. Unfortunately, respondents' interpretations of the scale were inconsistent in that many of them did not rate any topic as high as ten; apparently because a rating of ten represented some level of importance to them which was inappropriate. In an attempt to minimize the resulting discrepancies in data comparison, it was decided to convert the scale readings into proportions of the time spent on the entire course. This was done by summing the scale ratings of all topics listed under each course for each school, then dividing each rating by that sum. In this way, each school's rating of a given topic under a given course was represented as a porportion of the whole course.

Space was provided under each course for respondents to add topics which they felt had been omitted from the original list. Very few responses were received to this item.

In addition to rating the relative importance of each topic, respondents were asked to indicate the percentage of time spent on that topic which was devoted to lecture and to laboratory. For each course, the weekly clock hours scheduled for lecture and laboratory work, and the number of credit hours given was also requested.

The relative importance proportions, percent of lecture to laboratory for each topic, and overall clock hours and credit hours

for each course were submitted to digital computer analysis to ascertain their means and standard deviations. As a criterion for determining which topics should be included, the mean proportion obtained for each topic was used to calculate the total number of clock hours which should be spent on that topic. The means of overall lecture-to-laboratory hours indicated a structure of two lecture hours and four laboratory hours per week for all the drafting courses. Based upon a sixteen-week semester, this gave a total of ninety-six clock hours for each course. The total (lecture plus laboratory) hours to be spent on each topic was calculated by multiplying the proportion of the course for each topic by ninety-six, and rounding to the nearest whole number. If any such calculation resulted in less than one clock hour, the topic was dropped from the course. Lecture-laboratory hours for each remaining topic were calculated from their mean percentages, rounding to whole numbers and modifying slightly where necessary to maintain an overall course ratio of 2:4 clock hours (32:64 for the entire course of 96 hours).

An unorthodox statistical procedure was used in an attempt to resolve one difficulty which arose in the compilation of lists of course topics. It was mentioned earlier (page 279) that few responses were received to the "write-in" topics in each course. Those topics which were added by individual respondents were included in a

master list of topics under each course. It is difficult to say whether the lack of response to write-in topics was due to their not actually being taught, or the reluctance on the part of respondents to add items to an already quite comprehensive instrument. In the analysis of topic data, a write-in topic not rated by others was arbitrarily assigned a zero rating; therefore the mean proportion of these topics was low. In order to avoid compromising the reliability of the results under these conditions, a modification of Kendall's coefficient of concordance with tied ranks (Ferguson, 1966) was used. The coefficient of concordance is a measure of agreement between judges ranking a set of observations, and is therefore applicable to the respondents' ranking of topic importance. For this analysis, the rank order of topic importance was used rather than their proportion of the whole course. Thus the original scale values were used as ranking criteria. For perfect agreement among a set of m judges ranking the same N terms, the sums of ranks for each item tend to be in the arithmetic progression m, 2m, 3m, ... Nm. For total disagreement, the sums of ranks tend to be equal, near the mean rank sum, $m(N + 1)/2$. The procedure used for each course is as follows: first, the sums of ranks for each topic were obtained, including the write-in topics. Then, for the write-in topics, the worst possible condition, i.e., total disagreement among rankings, was assumed.

Under this condition, the sums of ranks for those topics should be equal to the mean sum of ranks, as indicated above. Thus, the mean sum of ranks was assigned to those topics, and the total difference between the obtained sums of ranks and the assigned mean sum of ranks was distributed uniformly among the remaining original rank sums (see Appendix A for sample calculation). The resulting set of rank sums then represented a condition which tended to compromise the arbitrary assignment of zero ratings to the write-in topics, i.e., to compromise the rejection of the null hypothesis that there was no agreement among respondents' rankings. The coefficient of concordance and its significance, using a chi-square test was then applied to the resulting rank sums. Since many of the topics were ranked equally, many ties in rank occurred, and a correction for ties was applied in determining the coefficient of concordance (Ferguson, 1966).

In every case where m (the number of respondents) exceeded three, the coefficient of concordance was found to be significant at at least the .01 level. The null hypothesis was therefore rejected, and it was concluded that agreement among respondents in ranking all topics, including write-ins, existed and was due to factors other than chance. Graphical summaries of course topic distributions among schools and their relative weights in each course are found in Figures 13 through 25.

AERONAUTICAL DRAFTING

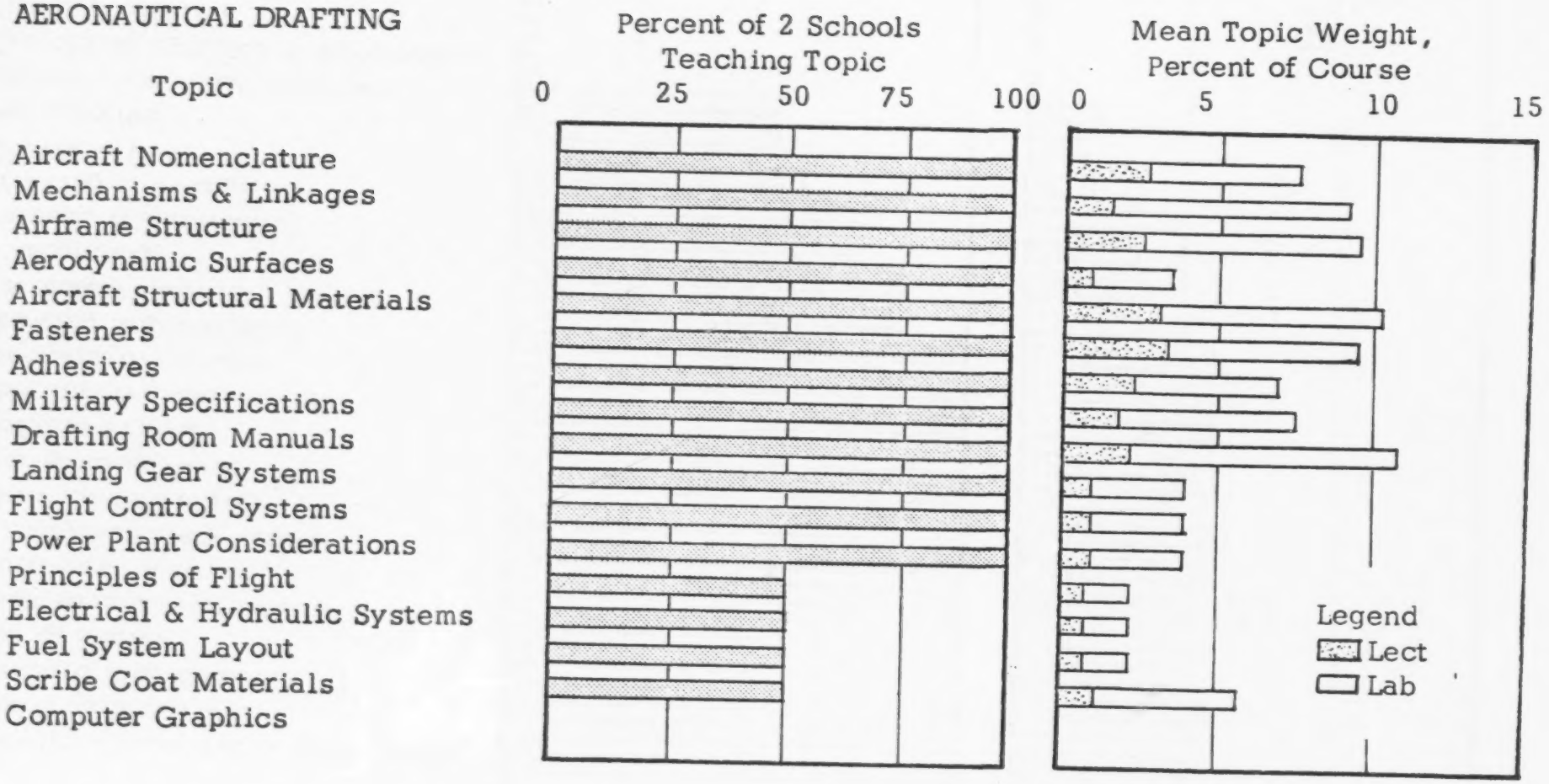


Fig. 13--Distribution of course topics in Aeronuatical Drafting

BASIC DRAFTING

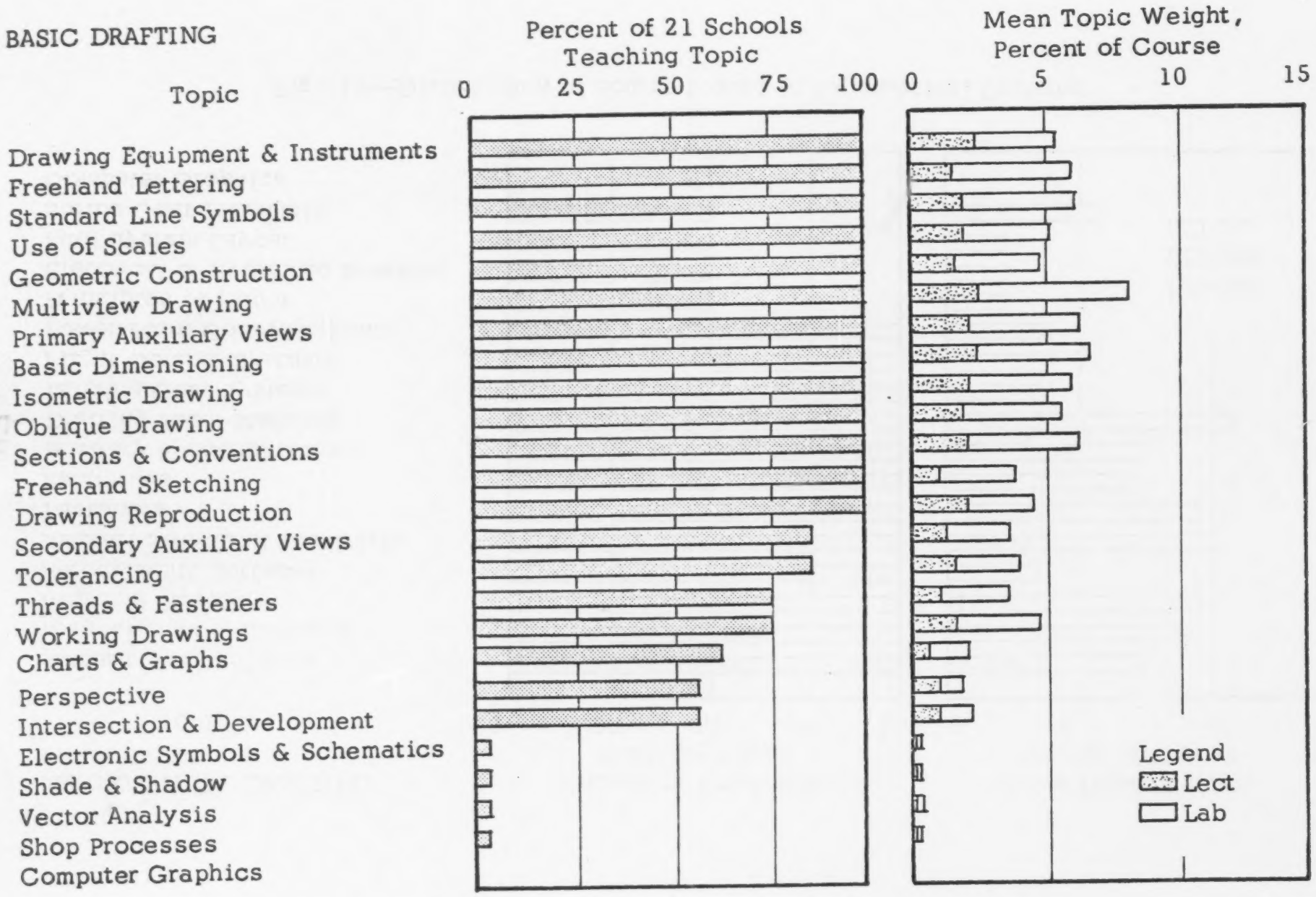


Fig. 14--Distribution of course topics in Basic Drafting

BUILDING CONSTRUCTION
DRAFTING I
Topic

Architectural Line Symbols
Architectural Lettering
Floor Plans
Elevations
Sections
Perspective
Foundation Plans
Site Plans
Electrical, Plumbing, Heating
Door & Window Details
History of Architecture
Styles of Architecture
Area Planning
Framing Plans
Schedules, Codes & Specs.
Modular Construction
Landscaping
Pictorials
Cost Estimating
Pencil, Ink, Paint Rendering
Shade & Shadow
Miscellaneous Details
Models
Field Practice
Computer Graphics

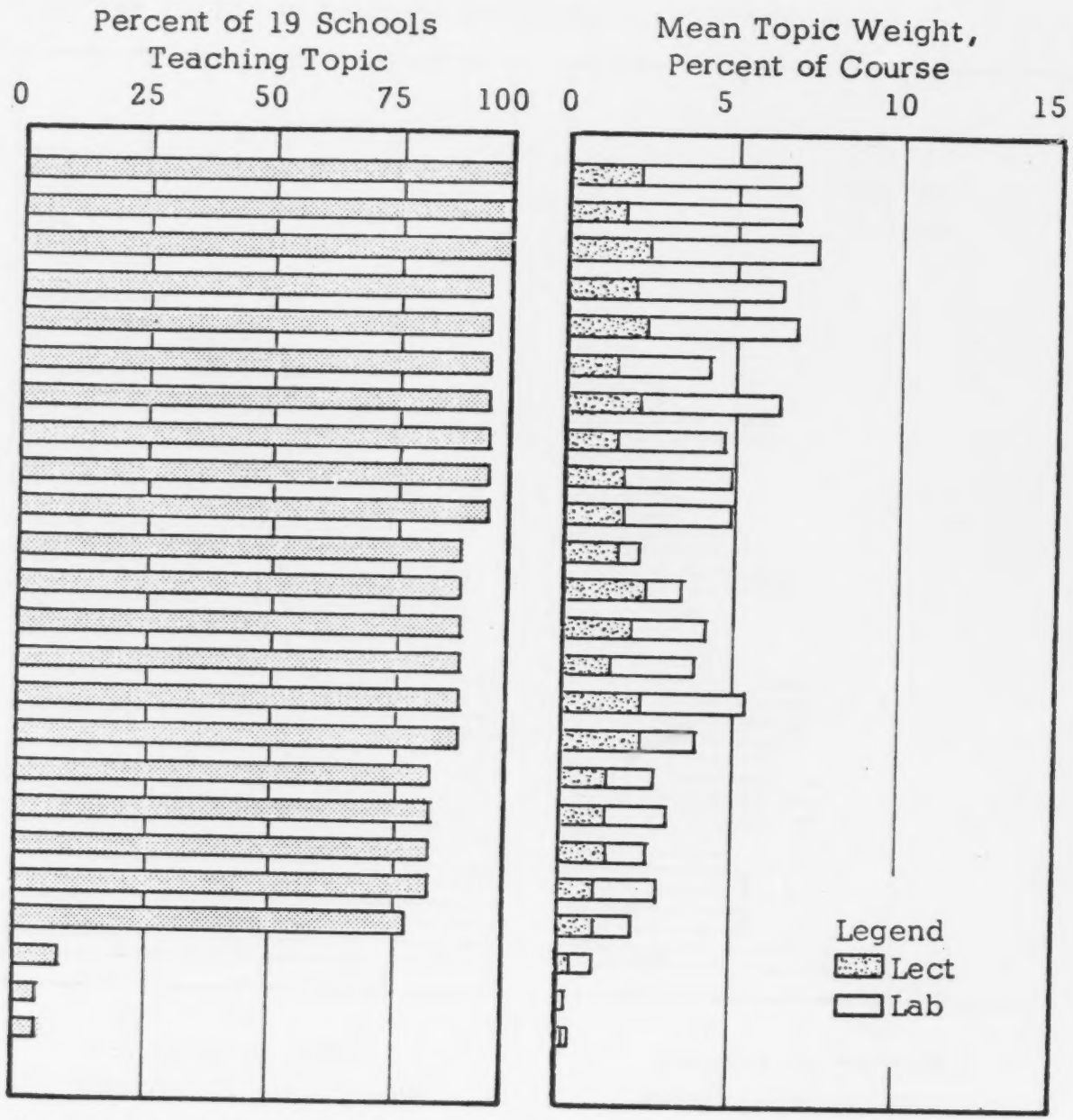


Fig. 15--Distribution of course topics in Building Construction Drafting I

BUILDING CONSTRUCTION
DRAFTING II
Topic

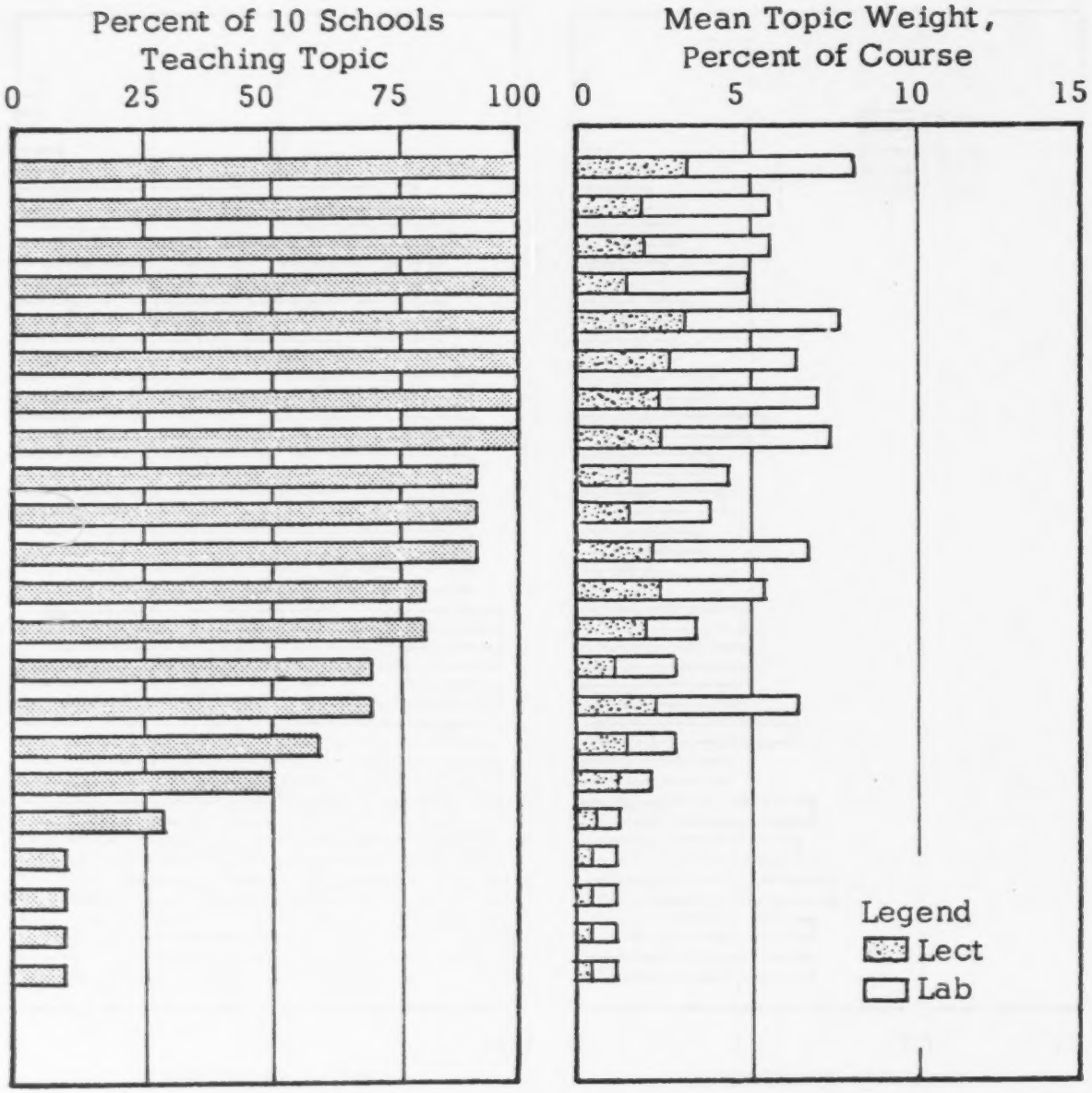


Fig. 16--Distribution of course topics in Building Construction Drafting II

DESCRIPTIVE GEOMETRY

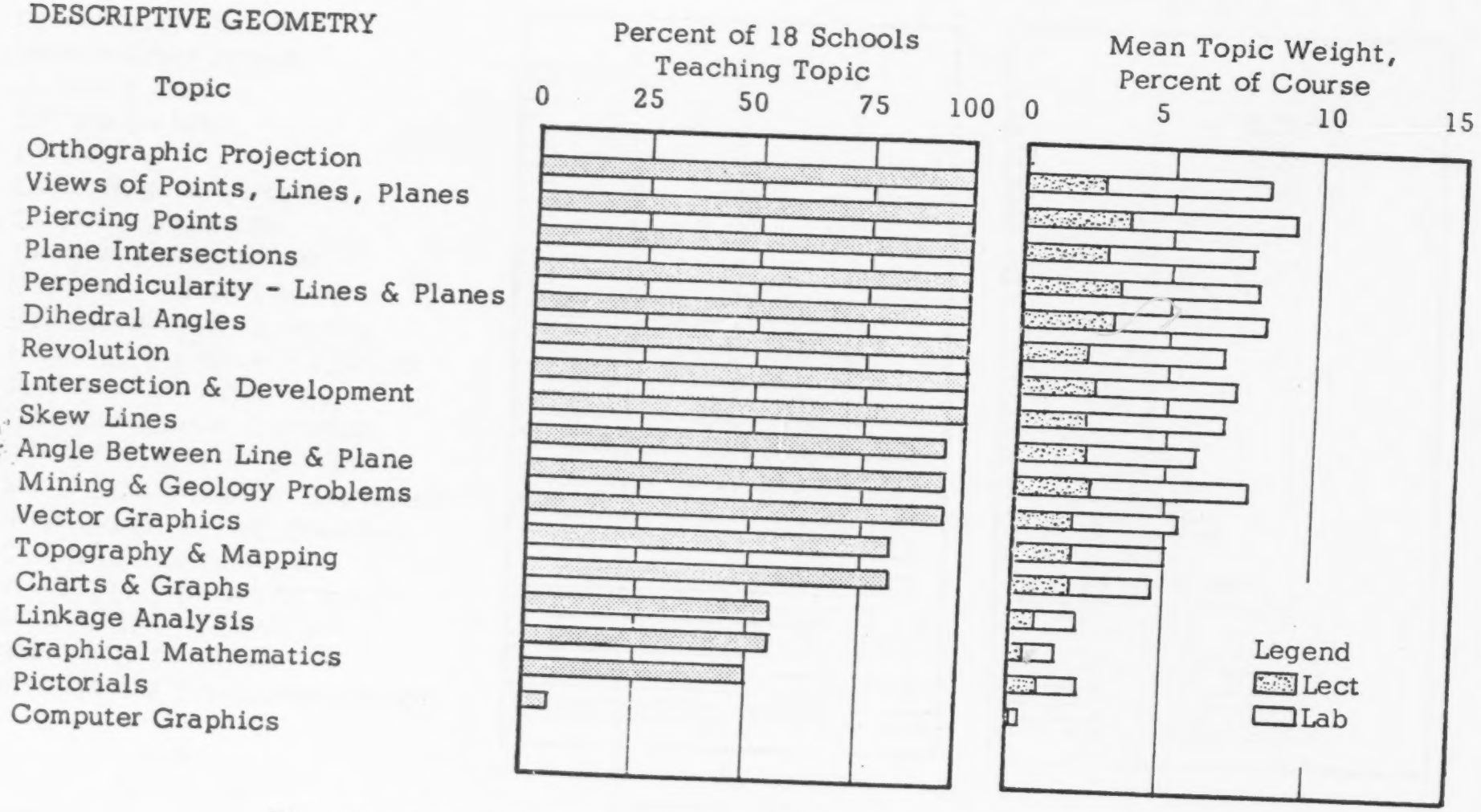


Fig. 17--Distribution of course topics in Descriptive Geometry

ELECTRICAL & ELECTRONIC DRAFTING
Topic

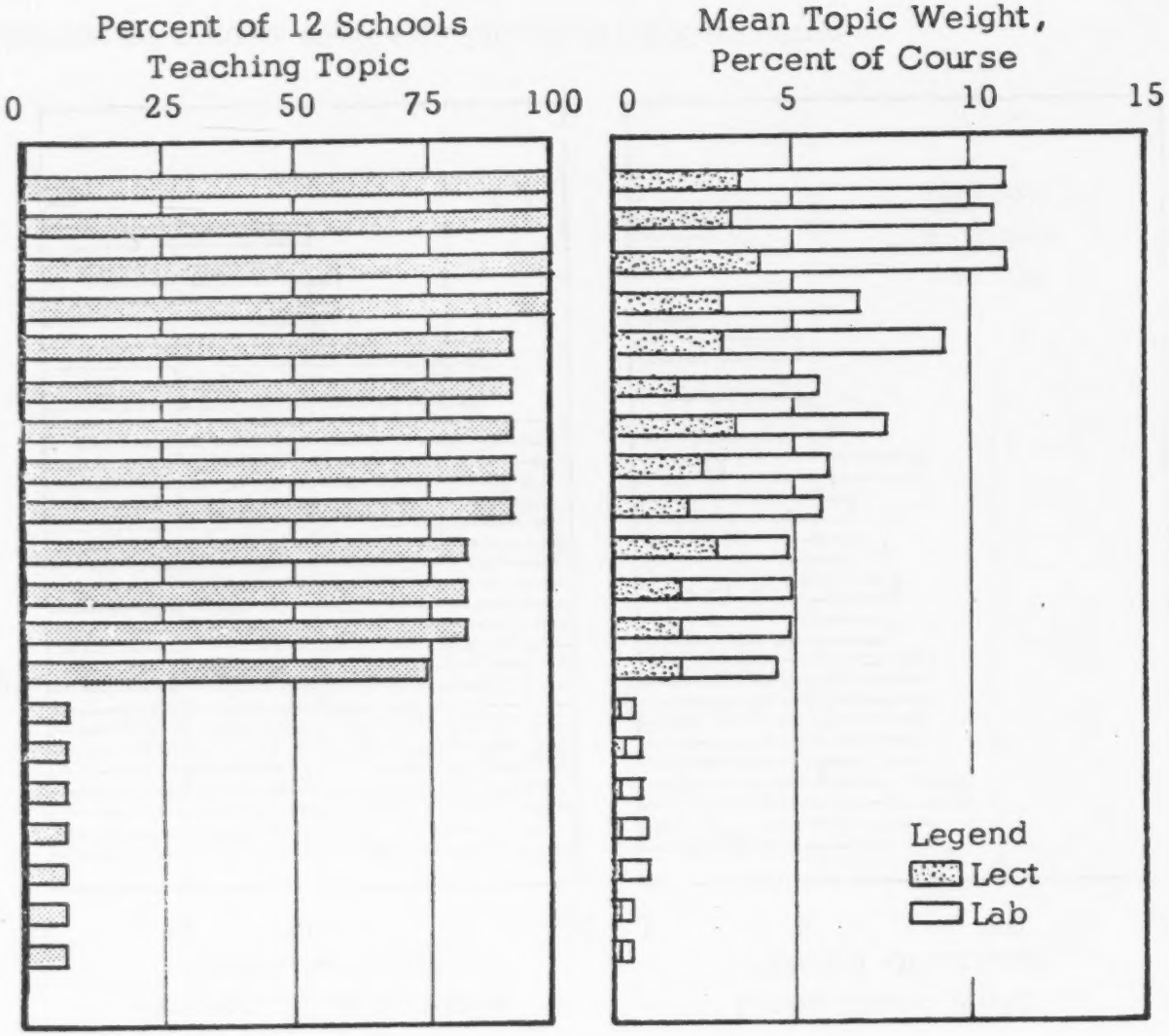


Fig. 18--Distribution of course topics in Electrical & Electronic Drafting

MACHINE DRAFTING

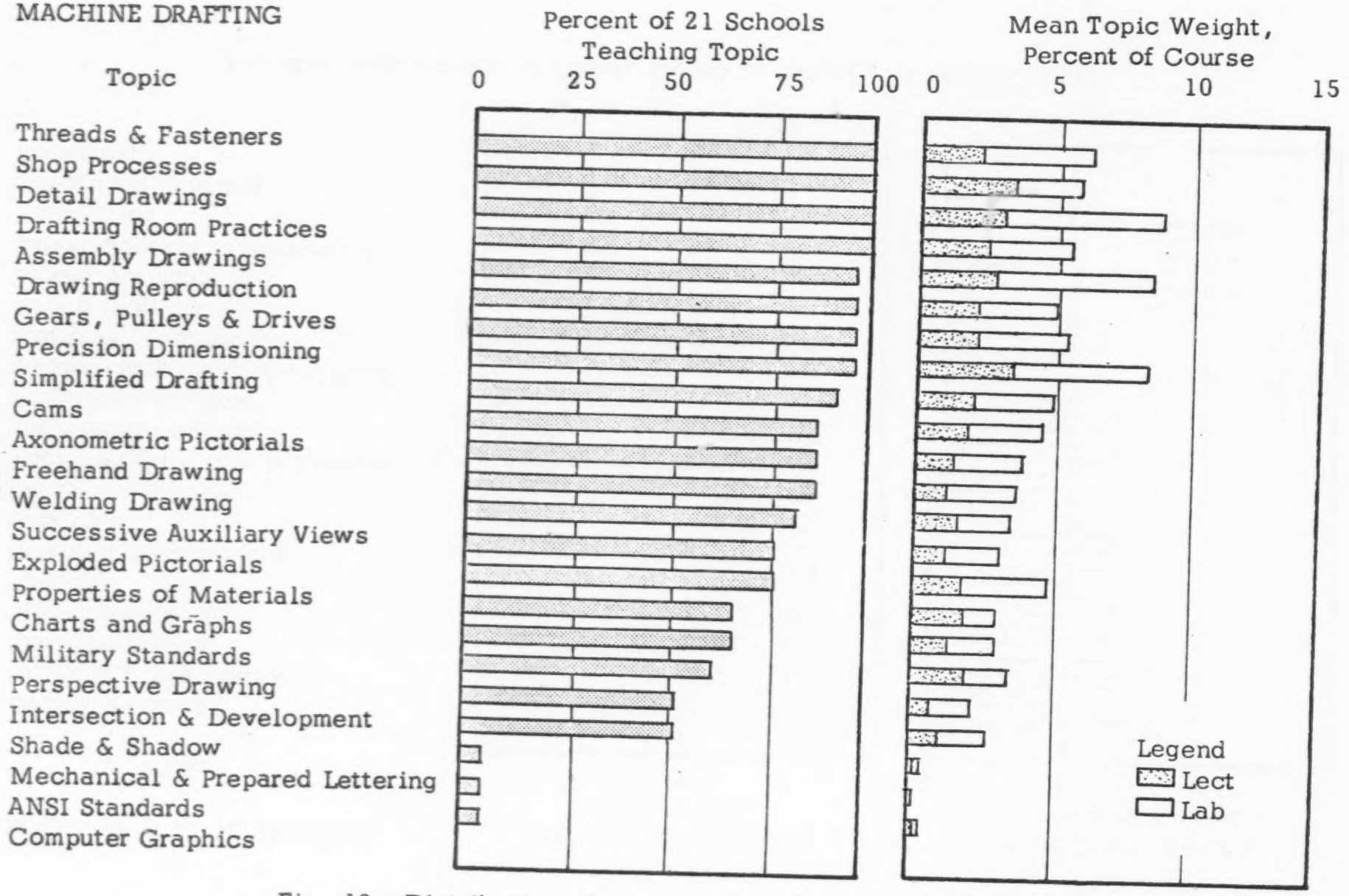


Fig. 19--Distribution of course topics in Machine Drafting

MACHINE & TOOL DRAFTING

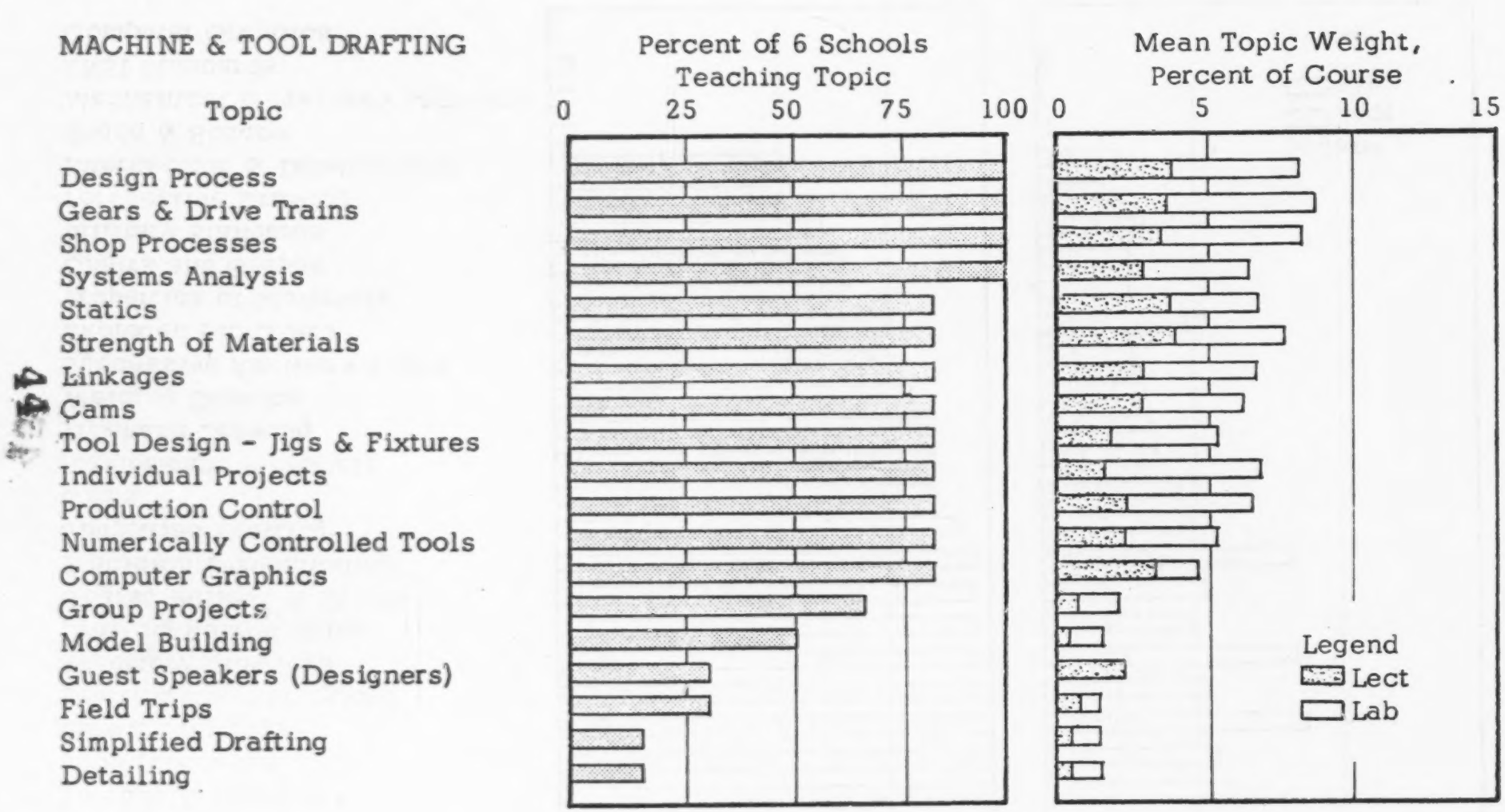


Fig. 20--Distribution of course topics in Machine & Tool Drafting

MAP & TOPOGRAPHIC DRAFTING

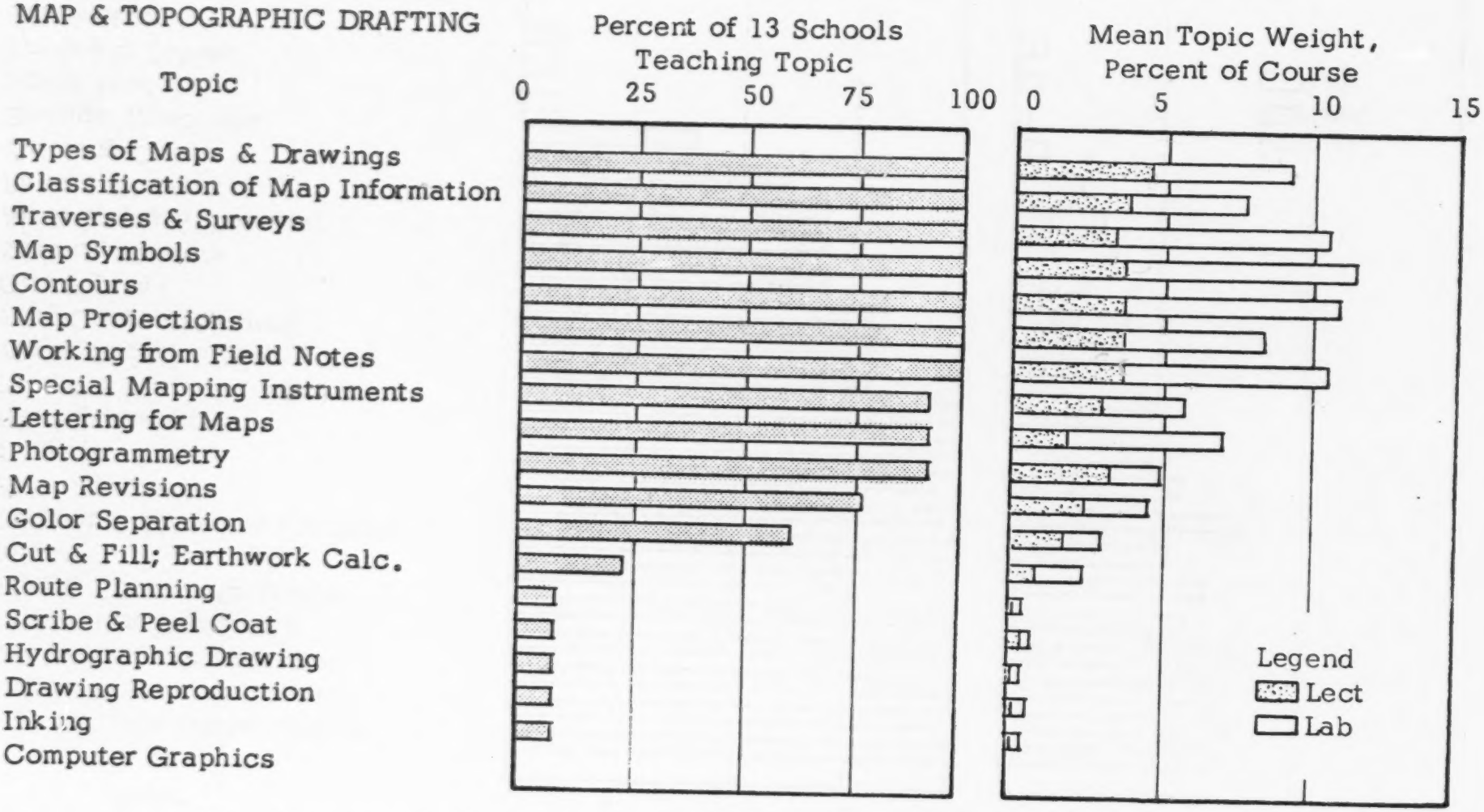


Fig. 21--Distribution of course topics in Map & Topographic Drafting

PIPE & VESSEL DETAILING

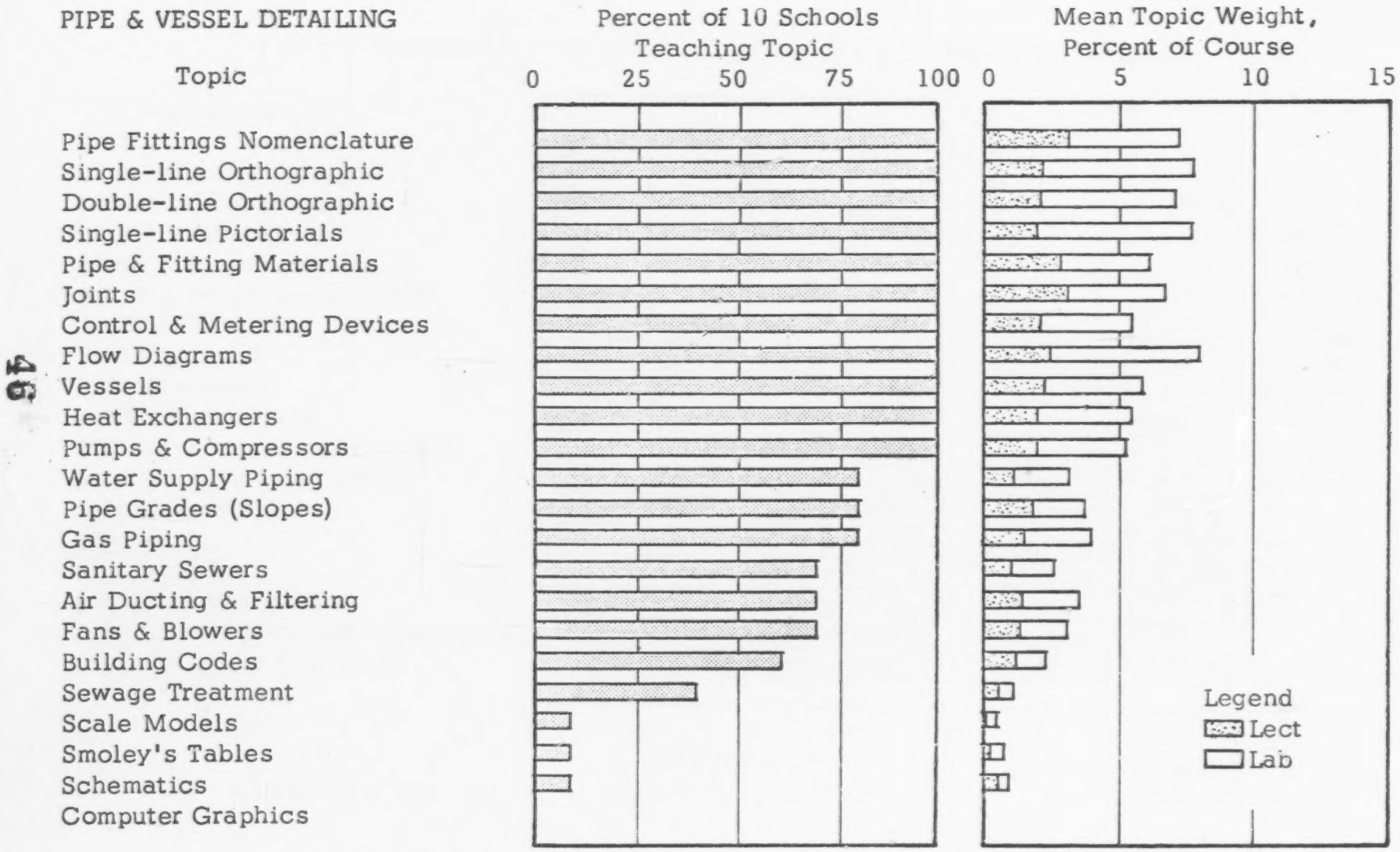


Fig. 22--Distribution of course topics in Pipe & Vessel Detailing

SHEET METAL DRAFTING

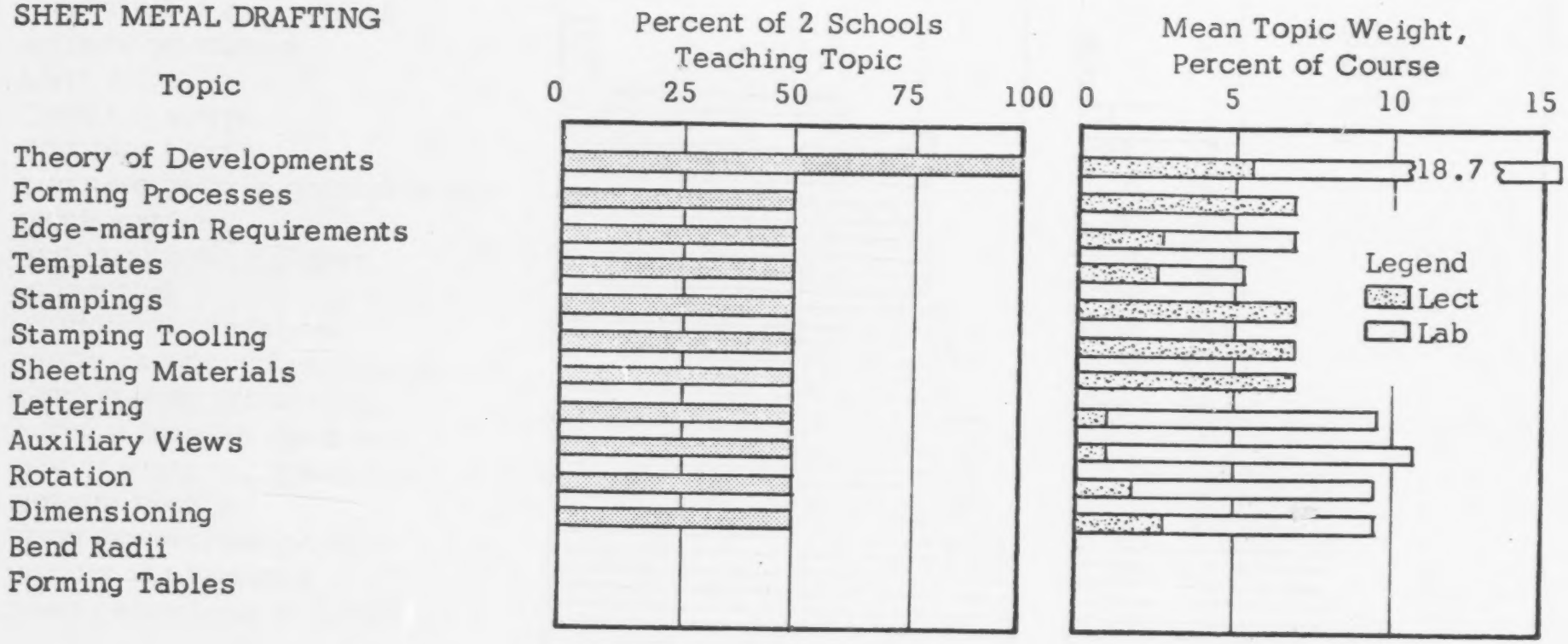


Fig. 23 --Distribution of course topics in Sheet Metal Drafting

STRUCTURAL DRAFTING I

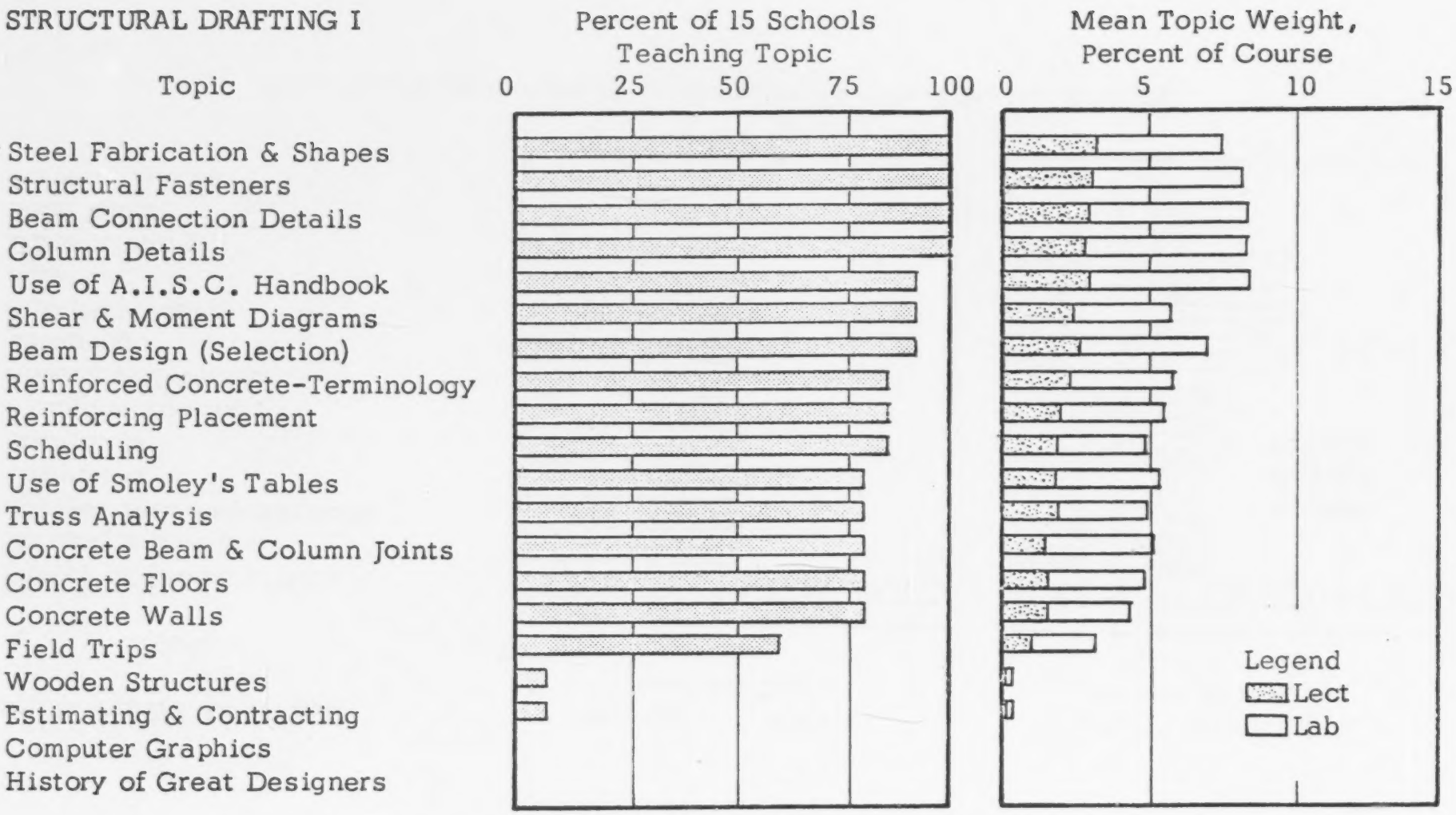


Fig. 24 --Distribution of course topics in Structural Drafting I

TECHNICAL ILLUSTRATION I

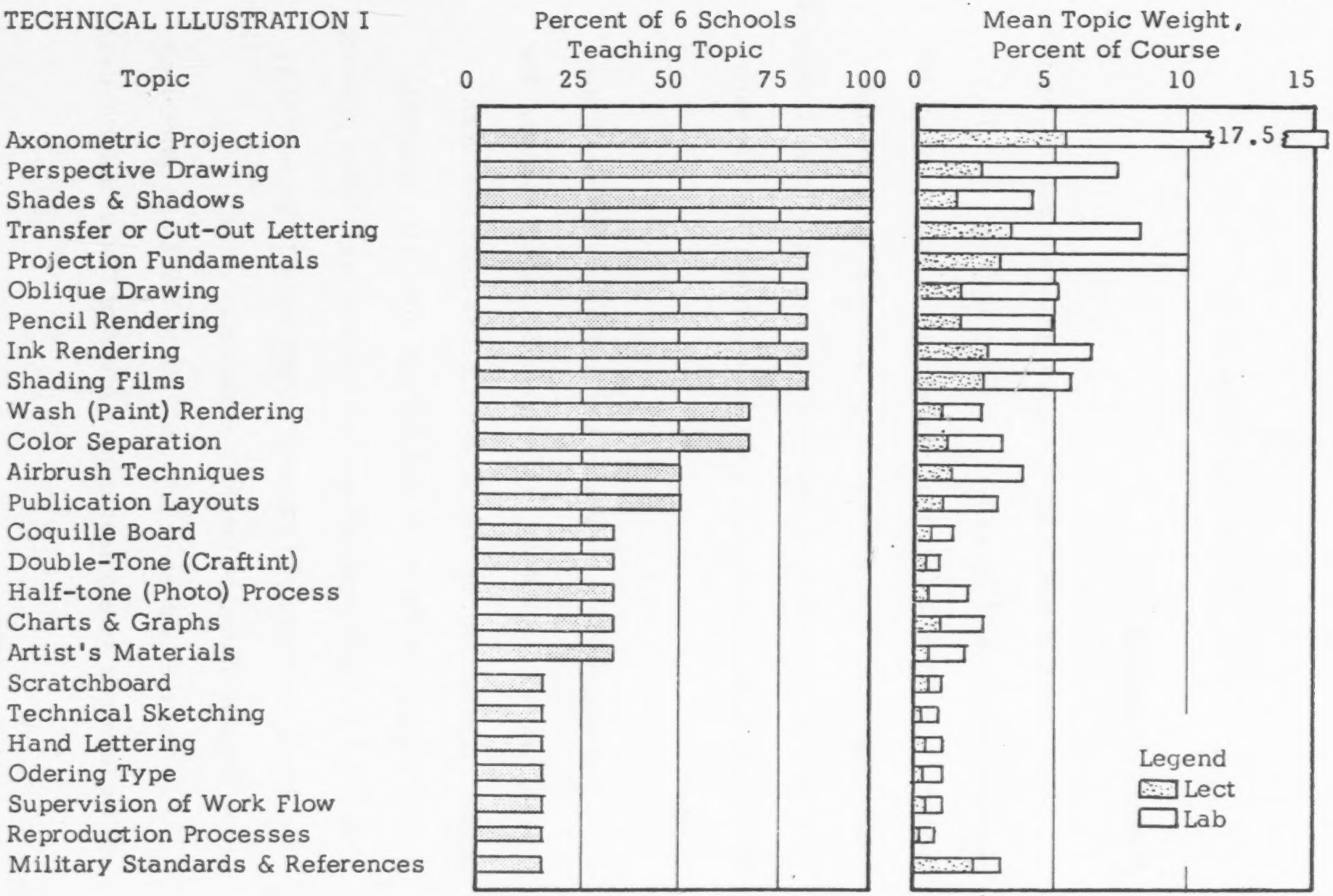


Fig. 25 --Distribution of course topics in Technical Illustration I

B. The Facilities Survey

Research Procedure

This research was planned to (1) obtain information about the physical facilities of Texas junior college drafting technology programs and (2) to gather suggestions and recommendations for drafting facilities from the drafting personnel at each college. Data for this research were gathered from inventory forms completed by college drafting personnel and from a personal visit to each college.

Preliminary steps.-- During the preliminary phase of this research, a visit was made to the Texas Education Agency. The need for research in the area of drafting was discussed with representatives of the junior college and technical-vocational programs. Facilitity guidelines that could be used when planning for drafting buildings and equipment were found to be needed by Texas State technical-vocational personnel.

During the summer of 1968, the basic ideas and objectives of this research were presented to a group of Texas junior college

drafting instructors and directors who were attending a workshop held at Texas A&M University. These educators were generally of the opinion that research on physical facilities would be very beneficial to them. The drafting personnel who were teaching at colleges with inadequate facilities were especially receptive to such a study.

Preparation and validation of the inventory form.--The purpose of the inventory form used in this study was to gather information about existing drafting facilities and to accumulate suggestions and recommendations for buildings and equipment that could be used in planning new or remodeling old drafting facilities. Facility guidelines from other states, journals and magazines, correspondence with jury members, and consultation with research committee members and drafting colleagues were the sources used to prepare the inventory form.

The jury members chosen to examine the inventory form were selected from among teachers and directors of drafting technology programs in Texas. After the inventory form was evaluated and criticized by several colleagues, copies of the

form were mailed to the jury members who made suggestions and recommendations as to readability, format, content, and validity. The recommendations of the jury were incorporated in the final revision of the form.

Because some of the information requested in the form could best be answered by the person in charge of the drafting program, two versions of the form were printed -- one for the drafting directors and one for the drafting instructors. The director's copy of the form contained the same information as the instructor's version plus several additional pages requesting departmental information. To help differentiate between the instructor's and director's form, the latter had "DIRECTOR'S FORM" printed on the cover.

The inventory form was printed on light yellow and light brown paper. The color of the cover was medium orange-tan with the larger indentification words in white and the less significant information in black. The cover contained an impressionistic sketch of the State of Texas indicating the location of the junior college drafting technology programs. To emphasize different items of the form, shading films and screens were used. Each section of the form was introduced by pictures identifying the information requested. Sample forms are included in Appendix B.

Selection of cooperating institutions.--The 1968-69 directory of Technical-Vocational programs was used to identify the junior colleges in Texas that had a drafting and design technology program. Thirty junior colleges were listed in the directory as having drafting programs (Table 15). Drafting personnel from twenty-seven colleges (90 percent) participated in this research. The geographical distribution of junior colleges included in this research is shown in Figure 26.

An initial letter was sent to the president of each college explaining the purpose of the research. The president was asked to return an accompanying form indicating whether his college would participate. If the college personnel chose to participate in the research, the name of the person in charge of their drafting technology program was requested.

After receiving notification that a school would participate, a letter and form were mailed to the person in charge of the drafting program to determine the number of drafting personnel in their department and the number of drafting laboratories. Afterward, the proper number of inventory forms were mailed to the drafting director accompanied by a letter explaining the procedure to follow when giving the forms to his instructors. Each instructor's form was accompanied by a letter of explanation and a return envelope.

TABLE 15

JUNIOR COLLEGES IN TEXAS OFFERING DRAFTING AND DESIGN TECHNOLOGY

College	Location
Alvin Junior College	Alvin
Amarillo College	Amarillo
Angelina College	Lufkin
Bee County College	Beeville
Brazosport Junior College	Freeport
Central Texas College	Killeen
Cisco Junior College	Cisco
College of the Mainland*	Texas City
Cooke County Junior College	Gainsville
Dallas County - El Centro	Dallas
Del Mar College	Corpus Christi
Galveston County College	Galveston
Grayson County College	Sherman-Denison
Henderson County Junior College	Athens
Hill Junior College	Hillsboro
Howard County Junior College	Big Spring
James Connally Technical Institute	Waco
Kilgore College	Kilgore
Lee College	Baytown
Navarro Junior College	Corsicana
Odessa College*	Odessa
San Antonio College	San Antonio
San Antonio - St. Philip's College	San Antonio
San Jacinto College	Pasadena
South Plains College	Levelland
Tarrant County - South Campus	Fort Worth
Temple Junior College	Temple
Texarkana College	Texarkana
Tyler Junior College*	Tyler
Wharton Junior College	Wharton

*Did not participate in research

Fig. 26--Geographical distribution of participating junior colleges

Table 16 shows the number of inventory forms that were returned by the directors and instructors. Twenty-five directors (93 percent) and thirty-eight instructors (75 percent) returned inventory forms.

A visitational sheet was included with the inventory form sent to the directors. After receiving the completed visitational sheets from each college, a schedule of visits to the colleges was planned. Care was taken to avoid duplication in travel, and yet, to visit the colleges at a time most convenient for them. Sample letters and visitational sheet are found in Appendix B.

Visits to the colleges.--The visits to the colleges were accomplished between January 15 and February 28 of 1969. An average of two and three-fourths hours was spent at each college and a total of sixty-one instructors and directors were visited.

While visiting the colleges, at least three items were specifically covered: (1) a general discussion about drafting facilities was held with the director and as many instructors as possible; (2) light meter readings were taken of the drafting rooms and instructors' offices; and (3) 35 mm colored slides and black and white pictures were taken.

TABLE 16

INVENTORY FORMS RETURNED FROM DIRECTORS AND INSTRUCTORS

	Number of Directors' Forms Returned	Number of Instructors	Number of Instructors' Forms Returned
Alvin Junior College	1		
Amarillo College	1	3	3
Angelina College	1	1	1
Bee County College	1	1	1
Brazosport Junior College		1	1
Central Texas	1		
Cisco Junior College	1		
Cooke County Junior College	1	2	2
Dallas County - El Centro	1	6	4
Del Mar College	1	6	3
Galveston County College	1	1	1
Grayson County College	1	2	2
Henderson County Junior College	1	1	1
Hill Junior College	1		
Howard County Junior College	1		
James Connally Technical Institute		6	1
Kilgore College	1	5	5
Lee College	1	2	1
Navarro	1	1	1
San Antonio College	1	2	2
San Antonio - St. Philip's College	1	1	1
San Jacinto College	1	3	3
South Plains College	1	1	
Tarrant County - South Campus	1	1	1
Temple Junior College	1	1	1
Texarkana College	1	1	1
Wharton Junior College	1	2	2
Totals	25	51	38

Conclusions of study.-- At the conclusion of this research, the colored slides and black and white pictures were forwarded to the Department of Vocational and Adult Education of the Texas Education Agency. The pictures and slides were stored in soft plastic holders in three-ring binders. The pictures were separated into categories such as tables, chairs and reproduction equipment. The slides taken at each college were kept together to describe the facilities at the various colleges.

Analysis of Data

Introduction.-- Data for this study were obtained from drafting personnel from junior colleges throughout Texas. The respondents were asked to indicate their existing physical facilities and to offer suggestions and recommendations that would be helpful in planning drafting facilities.

The following discussion includes consideration of equipment, storage and administrative facilities. Most of the data is presented to evaluate those facilities which were available at the colleges compared to facilities recommended by drafting personnel.

Statistical treatment.-- Because of the nature of this research, most of the data were analyzed by presenting the information in

percentages, means, and medians. To show the variation found among the colleges, the range was used. According to Ferguson (1959), the range may be effectively used with small samples.

Architectural characteristics and furnishings include such items as location of drafting room, illumination, flexibility, and ventilation.

Location of drafting rooms.--Twenty-three drafting directors (88 percent) indicated that their drafting laboratories were located on either the main or second floor (Figure 27). When asked where a drafting room should be located, thirty-six respondents (84 percent) recommended the main or second floor of a building. In analyzing Figure 27, it is quite evident that most drafting personnel were satisfied with the location of their drafting room whether it be located in a basement or on the sixth floor.

Size of doors.--Often the doors leading into classrooms or drafting rooms are unnecessarily narrow. An investigation of the existing drafting facilities revealed that only twelve percent of the drafting rooms had doors four feet or wider (Figure 28). When asked to recommend the width for entrance doors, forty instructors (95 percent) expressed a need for one or two doors four feet or wider.

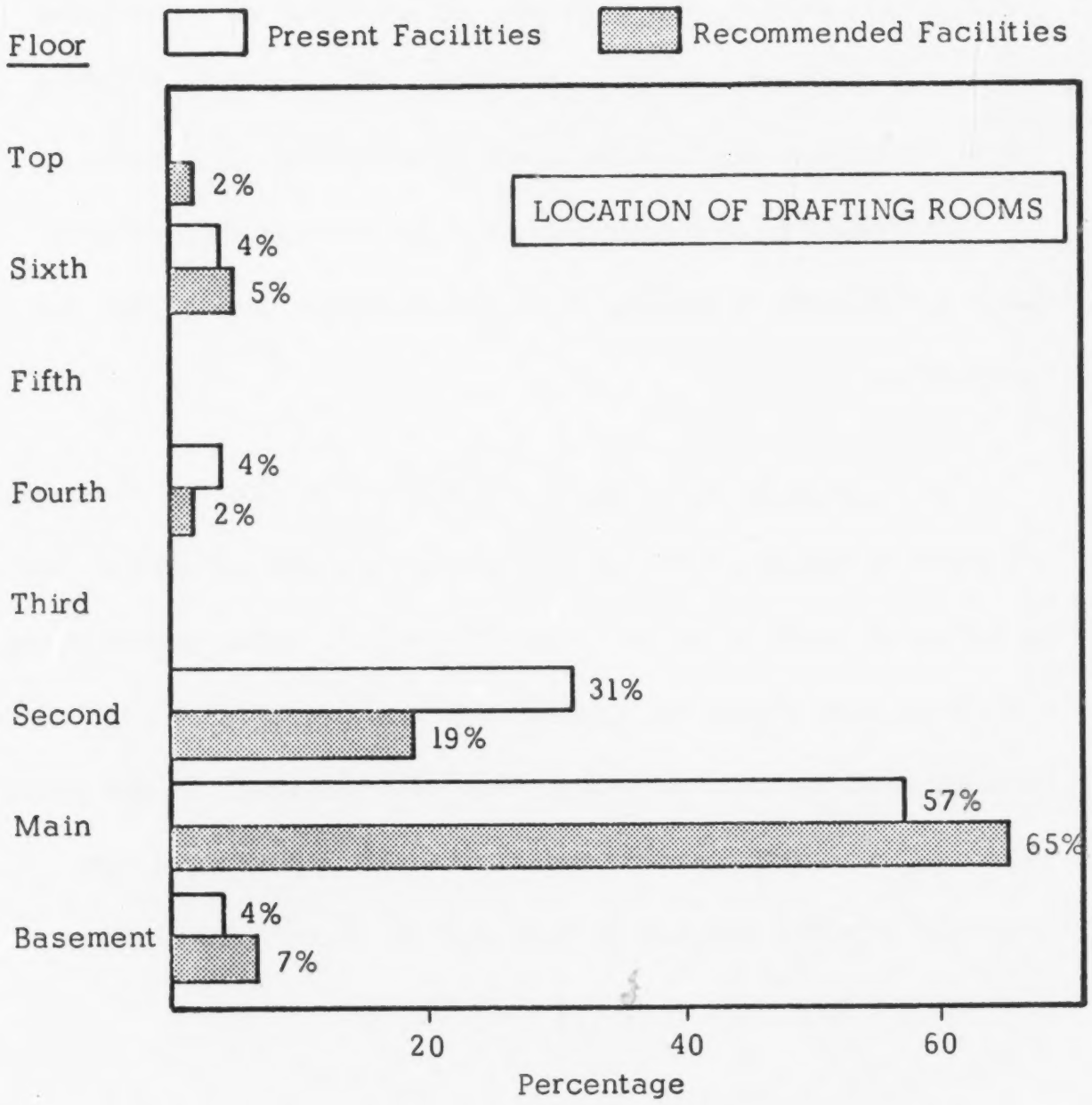


Fig. 27--Locations of drafting rooms

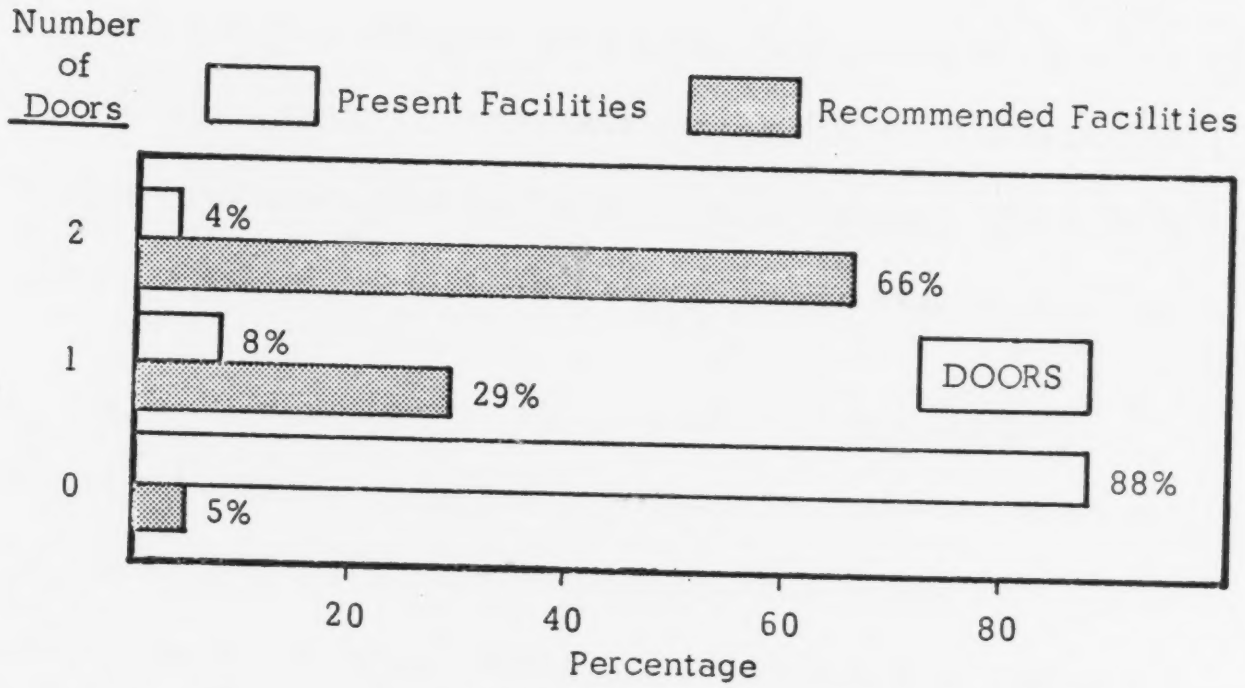


Fig. 28 --Number of entrance doors into drafting rooms wider than four feet

Summary:

	Mean	Median	Range
Present Facilities:	.2	0	2-0+1=3
Recommended Facilities:	1.5	2	2-0+1=3

Flexibility.-- Although flexibility is frequently mentioned as desirable in literature on educational planning, only one college had provisions for altering the size of their drafting rooms (Figure 29). Flexilibity, in terms of portable or accordion walls, was recommended by only twelve drafting personnel (29 percent).

Width of aisles.-- Narrow aisles in drafting rooms often inhibit the movement of instructors and students within the laboratory. The present and recommended width of aisles is shown in Figure 30. The most frequently reported width of aisle was thirty-six inches; however, seventeen (28 percent) of the drafting rooms had less than thirty-six inches and fourteen (24 percent) had more than thirty-six inches. The summary at the bottom of Figure 30 shows a range of fifty-eight and forty-nine inches respectively for present and recommended facilities. The mode, or most frequently occurring response, shifted from thirty-six inches to forty-eight inches when the drafting instructors were asked to recommend a desirable aisle width.

Wash basins.-- Wash basins were considered by many instructors as a very desirable feature of a well designed drafting room. Figure 31 illustrates that twenty-two instructors (37 percent)

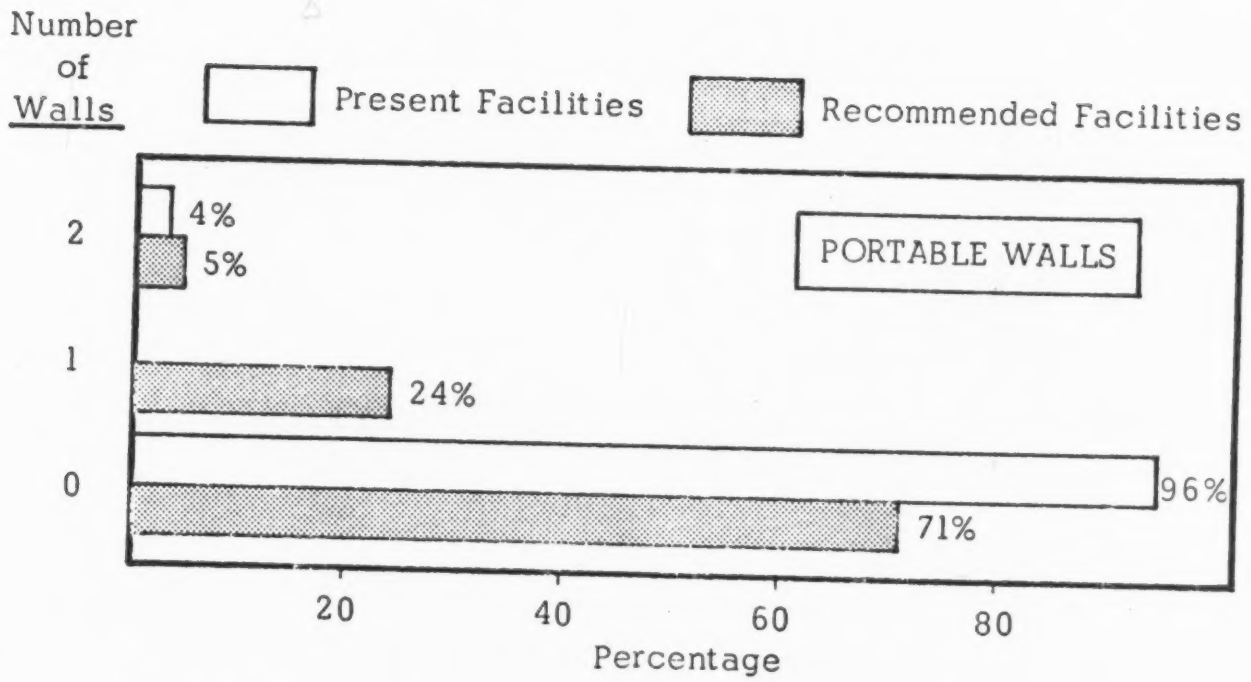


Fig. 29--Number of movable walls in drafting rooms

Summary:

	Mean	Median	Range
Present Facilities:	.1	0	2-0+1=3
Recommended Facilities:	.3	0	2-0+1=3

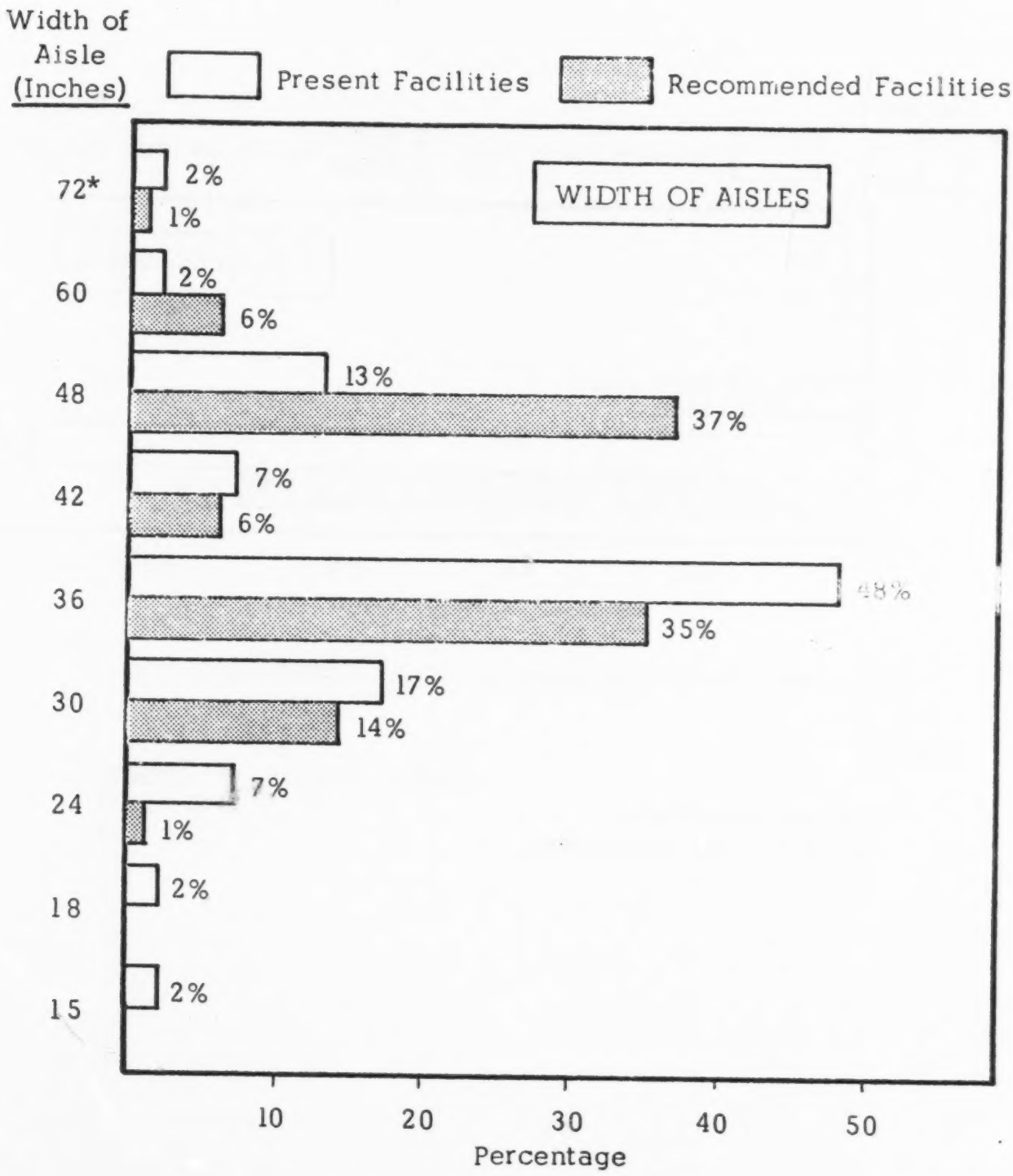


Fig. 30--Width of aisles in drafting rooms

Summary:

	Mean	Median	Range
Present Facilities:	36.4	36	72-15+1=58
Recommended Facilties:	45.0	42	72-24+1=49

*These numbers indicate raw data rather than class intervals.

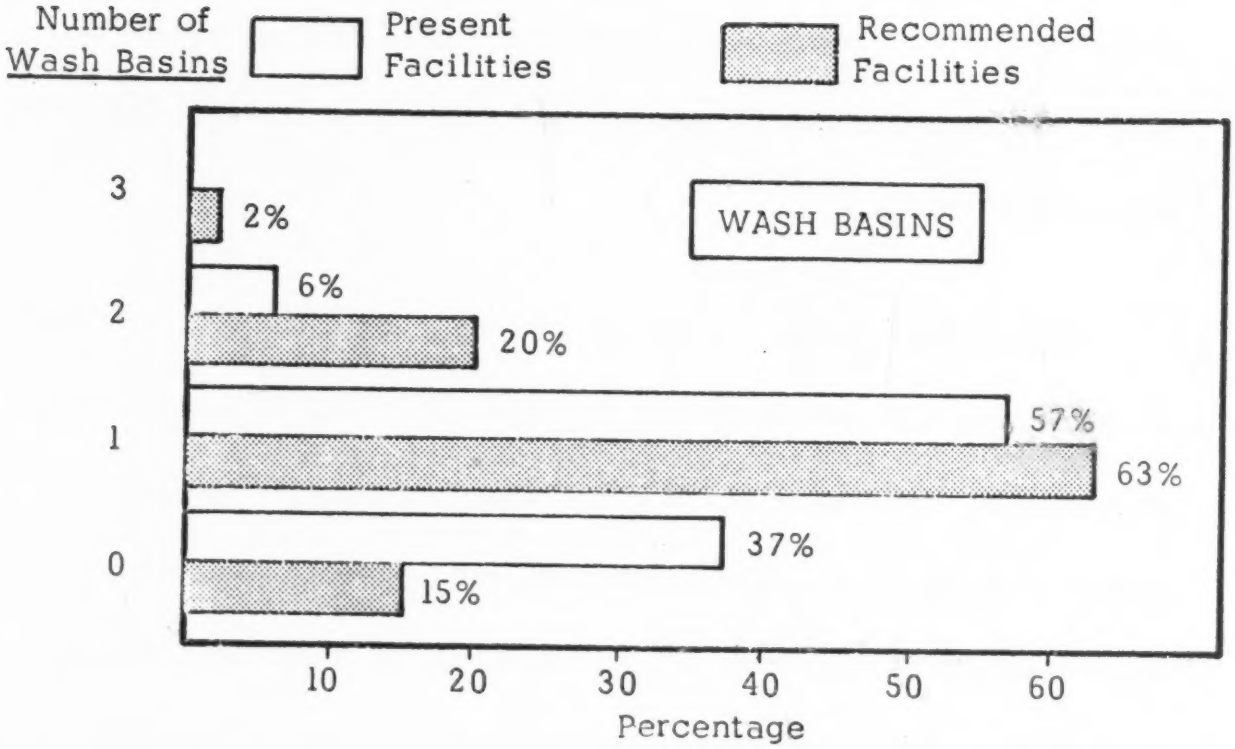


Fig. 31--Number of wash basins in drafting rooms

Summary:

	Mean	Median	Range
Present Facilities:	.7	1	2-0+1=3
Recommended Facilities:	1.0	1	3-0+1=4

did not have a wash basin; whereas, thirty-nine drafting personnel (85 percent) recommended at least one wash basin in a drafting room. Ten instructors (22 percent) recommended two or more wash basins per room.

Men's rest rooms.-- The present and recommended locations of rest rooms for men is shown in Figure 32. Eighteen directors (67 percent) reported that their rest rooms were within sixty feet of the drafting room. Three directors (11 percent) indicated that their men's rest room was not on the same floor as the drafting laboratory. Forty-one instructors (93 percent) recommended that rest rooms be located within sixty feet of the drafting room.

Women's rest rooms.-- Figure 33 shows the present and recommended location of the women's rest rooms. A comparison of Figures 32 and 33 shows little difference, except that eight percent fewer respondents recommended the women's rest room be within sixty feet of the drafting room.

Air conditioning.-- Central air conditioning was in twenty-three colleges (85 percent). Figure 34 illustrates that three drafting

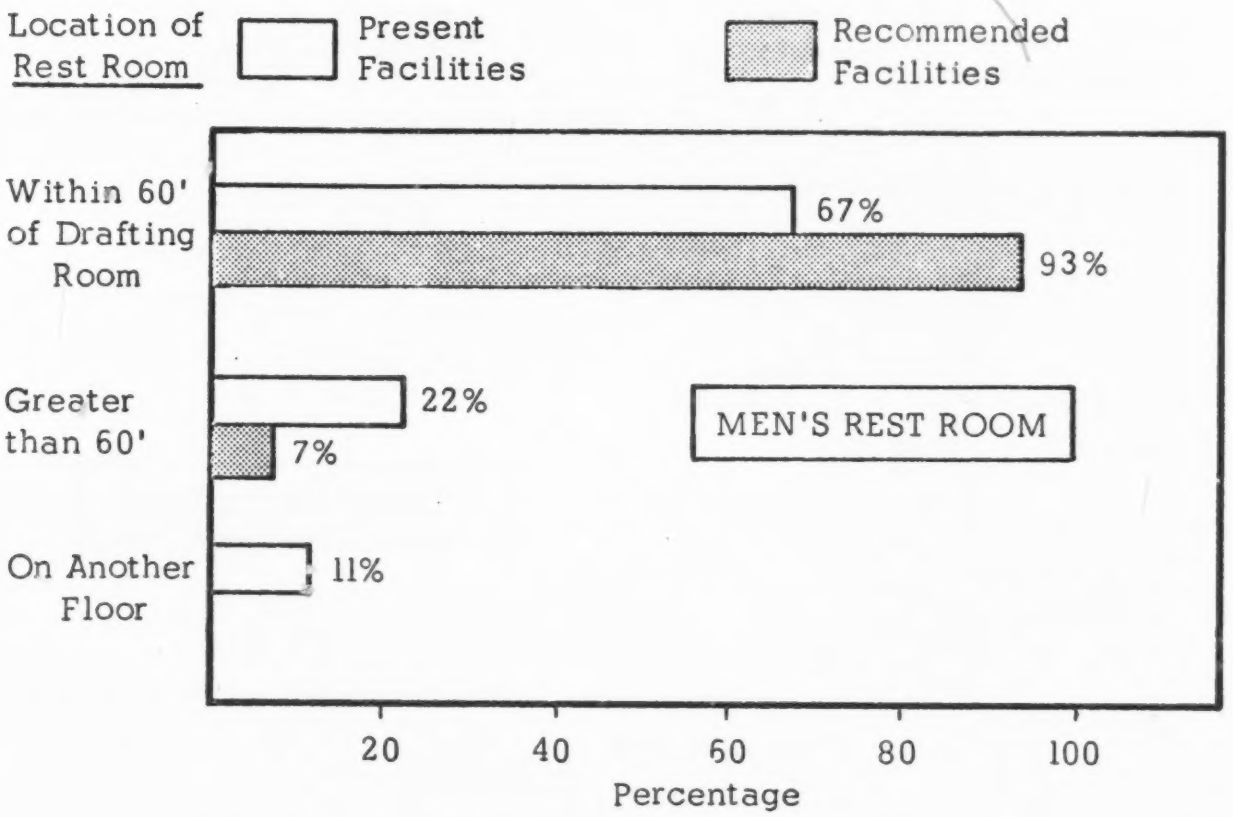


Fig. 32 --Location of men's rest rooms

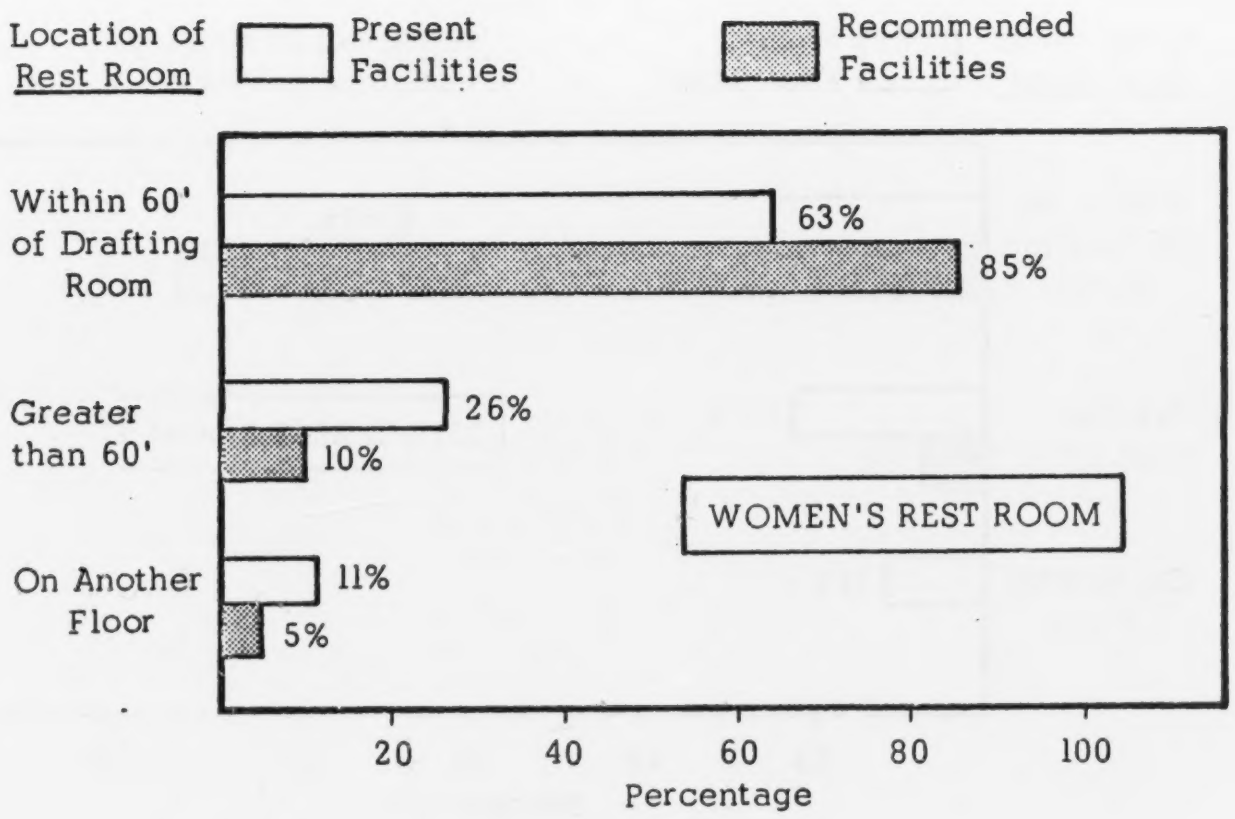


Fig. 33--Location of women's rest rooms

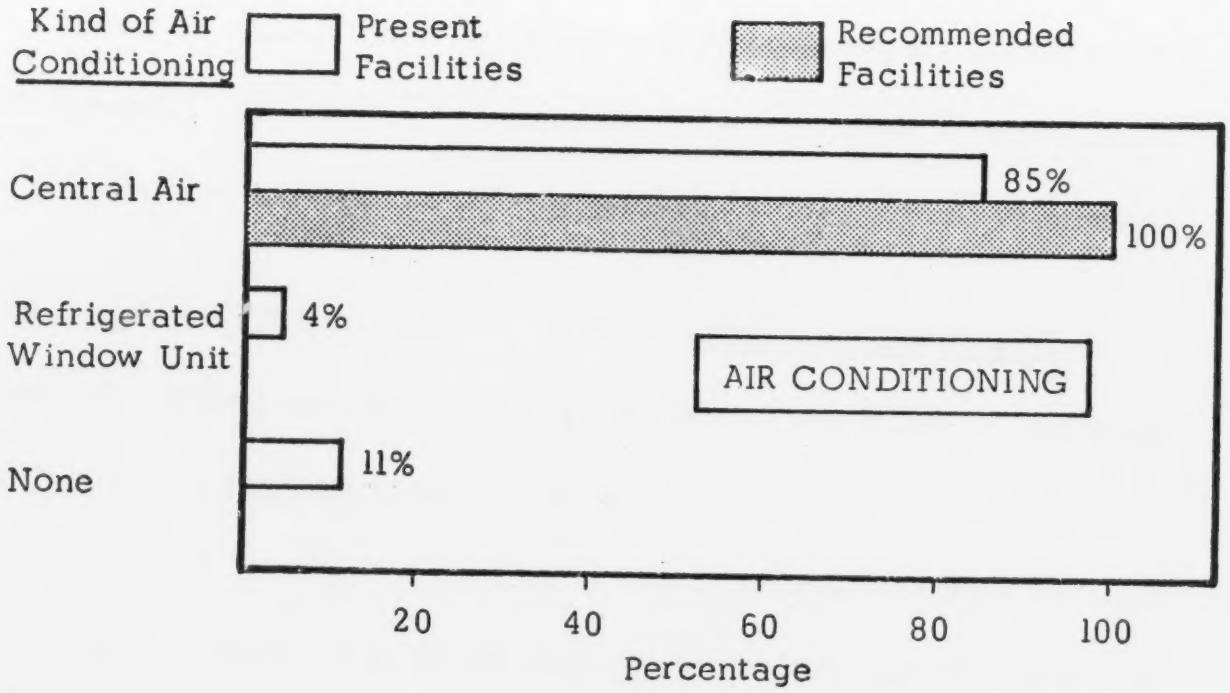


Fig. 34--Type of air conditioning in drafting rooms

departments (11 percent) were without air conditioning and one department (4 percent) had a refrigerated window unit. One hundred percent of the respondents recommended central air conditioning.

Spot ventilating units.--Spot ventilating units were frequently reported as being needed to vent reproduction equipment. Figure 35 illustrates that twelve directors (45 percent) indicated they had one or more spot ventilating units; whereas, thirty-two instructors and directors (76 percent) recommended one or more units.

Electrical outlets.--Electrical outlets were found on many of the expensive drafting tables. Fifteen directors (55 percent) reported that none of their drafting tables had 110 volt electrical outlets; whereas, twenty instructors (65 percent) recommended that each drafting table have a 110 volt outlet (Figure 36).

Ceiling heights.--The ceiling heights in the drafting rooms varied from eight to twelve feet with ten feet as the most common. Figure 37 illustrates that one respondent (2 percent) recommended a seven foot ceiling and thirty people (75 percent) recommended either a nine or ten foot ceiling.

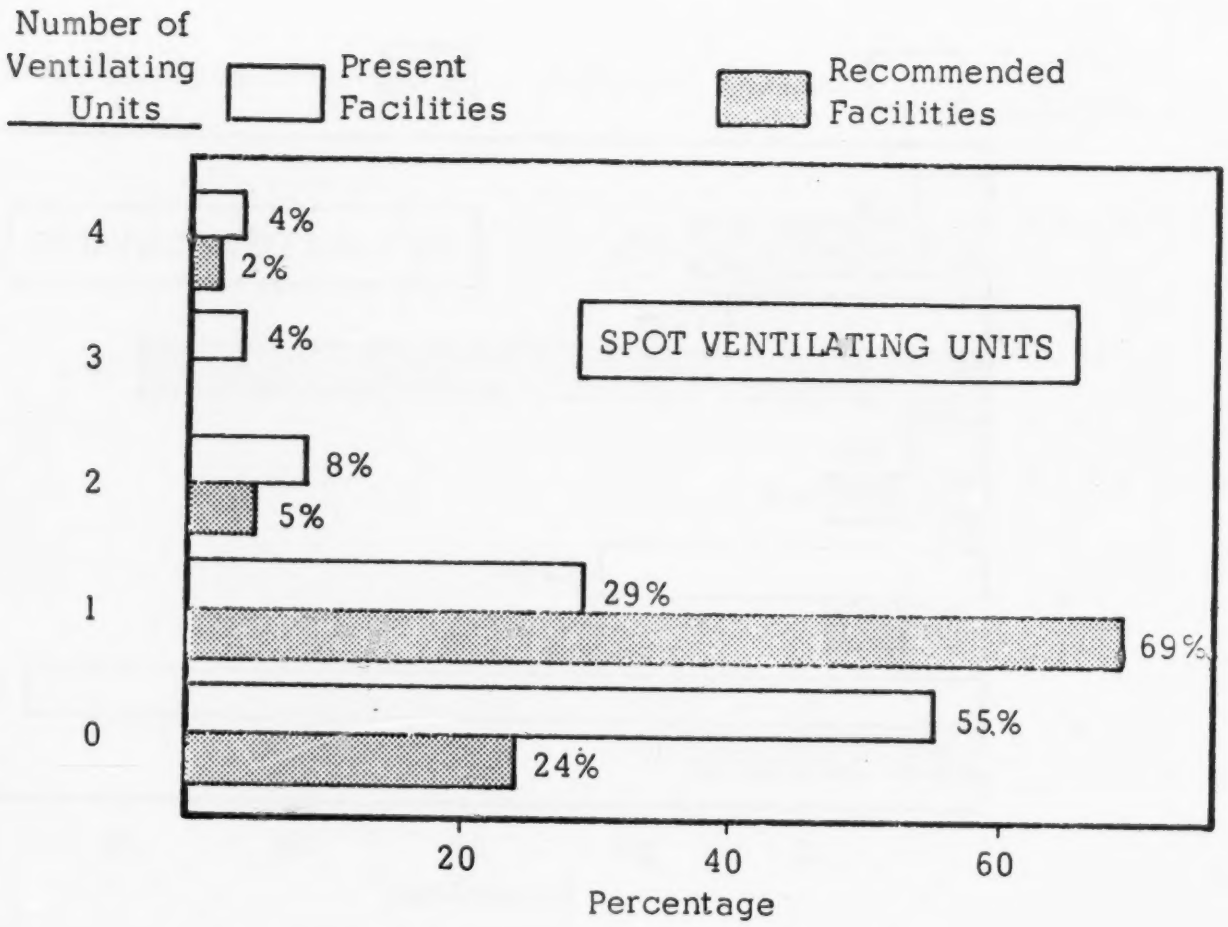


Fig. 35 --Number of spot ventilating units in drafting facilities

Summary:

	Mean	Median	Range
Present Facilities:	.7	0	4-0+1=5
Recommended Facilities:	.9	1	4-0+1=5

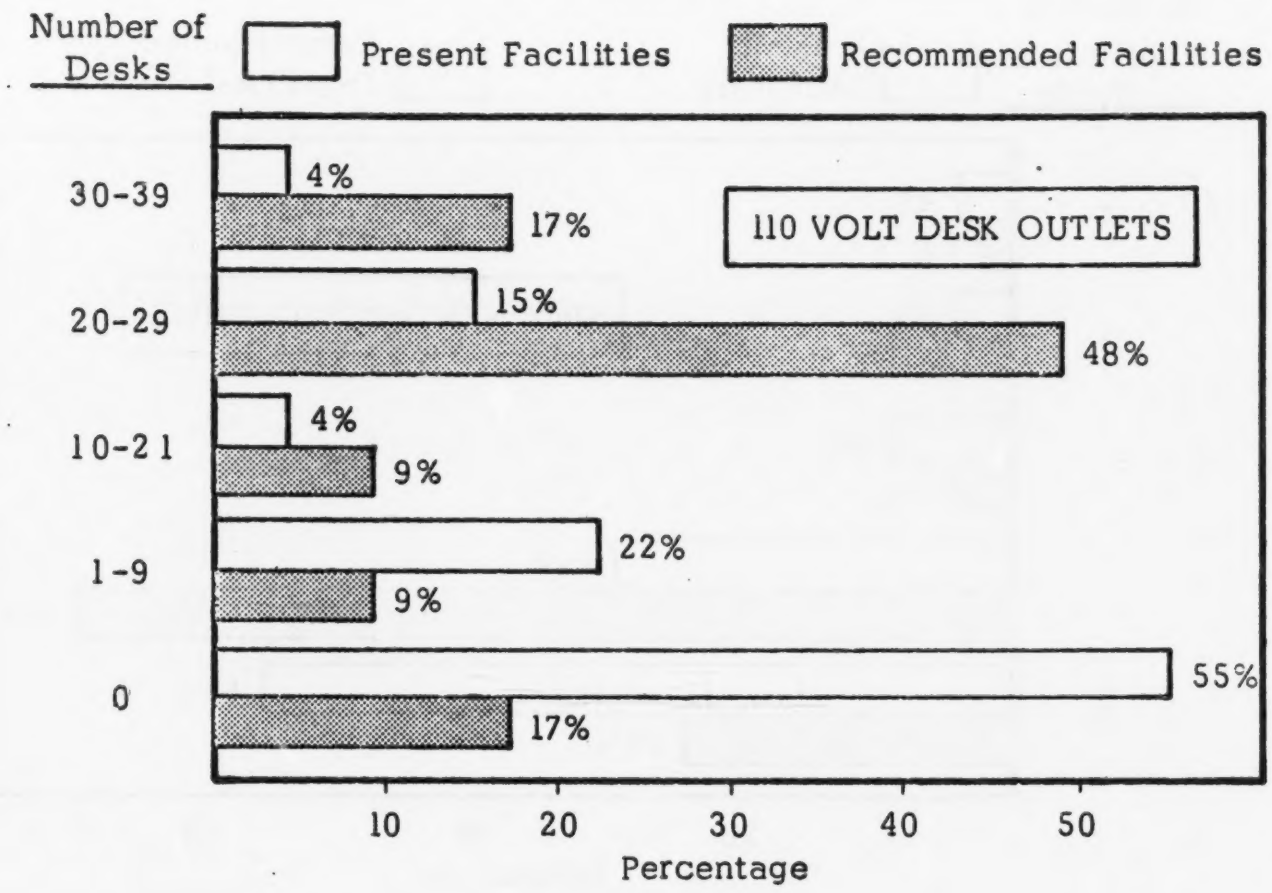


Fig. 36 --Number of drafting tables with 110 volt electrical outlets

Summary:

	Mean	Median	Range
Present Facilities:	7	0	30-0+1=31
Recommended Facilities:	19	25	30-0+1=31

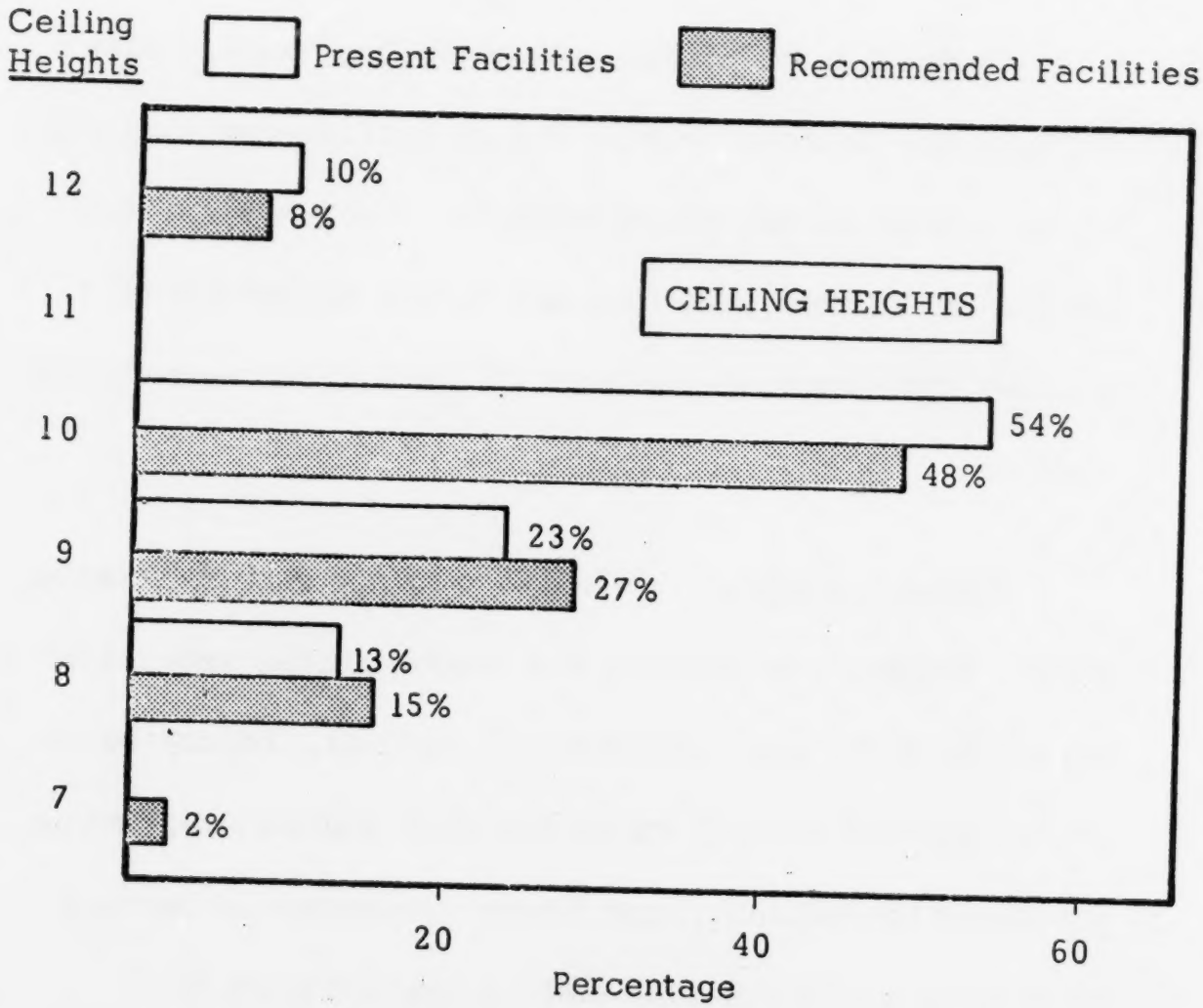


Fig. 37 --Height of ceilings in drafting rooms

Summary:

	Mean	Median	Range
Present Facilities:	9.7	10	12-8+1=5
Recommended Facilities:	9.5	10	12-7+1=6

Windows.--The window area in drafting rooms is shown in Figure 38. Thirteen colleges (55 percent) reported from one to one hundred square feet of windows. Eighteen instructors (57 percent) recommended from zero to fifty square feet of windows and sixteen respondents (38 percent) recommended no windows.

Window coverings.--Window coverings such as venetian blinds, draperies or curtains, and window shades were recommended by thirty-four instructors (62 percent). Twenty-seven respondents (43 percent) stated that their drafting room had no provisions for darkening, and fifteen instructors (24 percent) reported no windows in their drafting rooms (Figure 39).

Chalkboard.--The area of chalkboard in drafting rooms ranged from 24 to 720 square feet. Figure 40 illustrates that the most common chalkboard size ranged from 50 to 99 square feet of area.

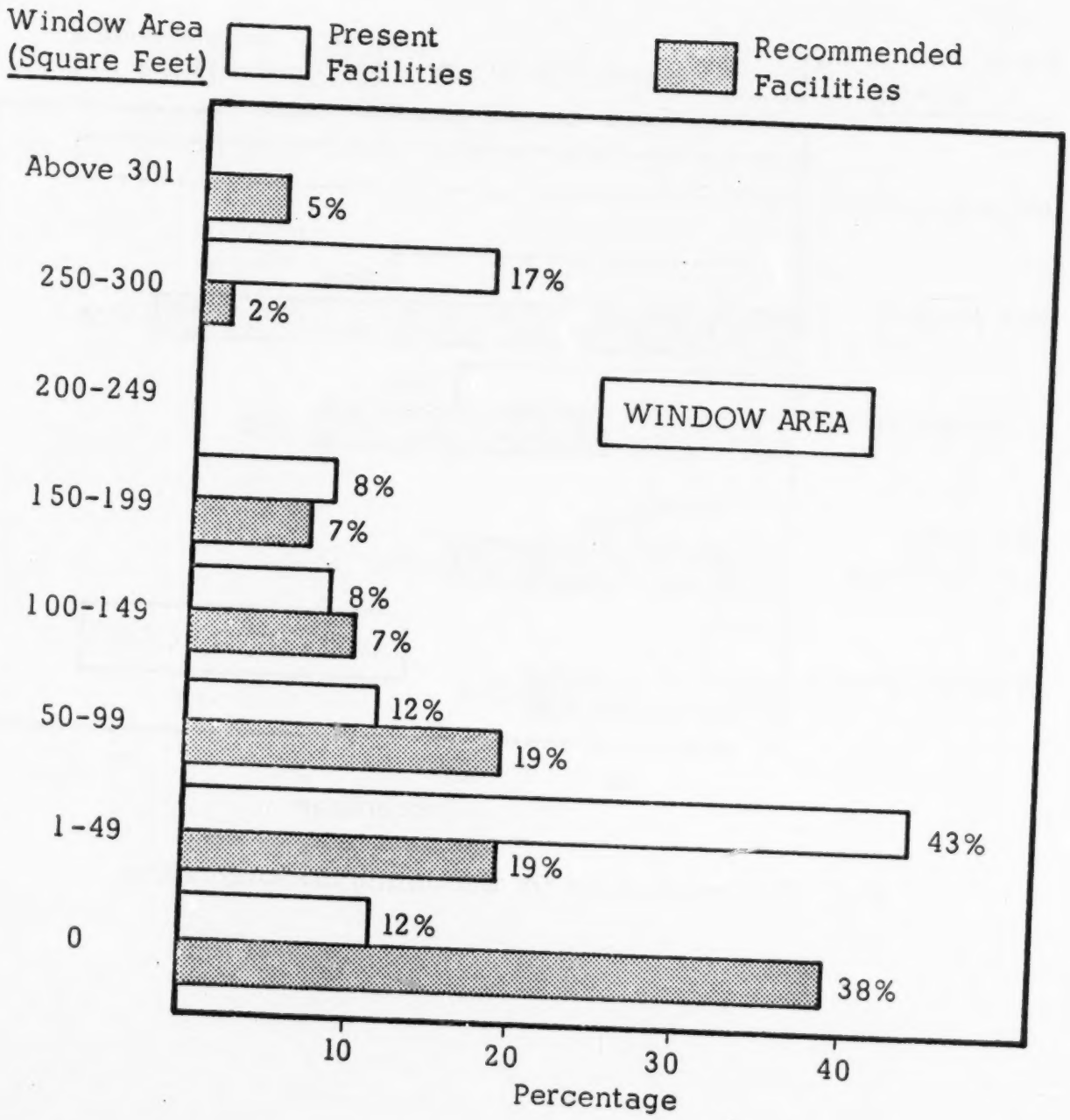


Fig. 38 --Area of windows in drafting rooms

Summary:

	Mean	Median	Range
Present Facilities:	91	45	286-0+1=287
Recommended Facilities:	65	32	800-0+1=801

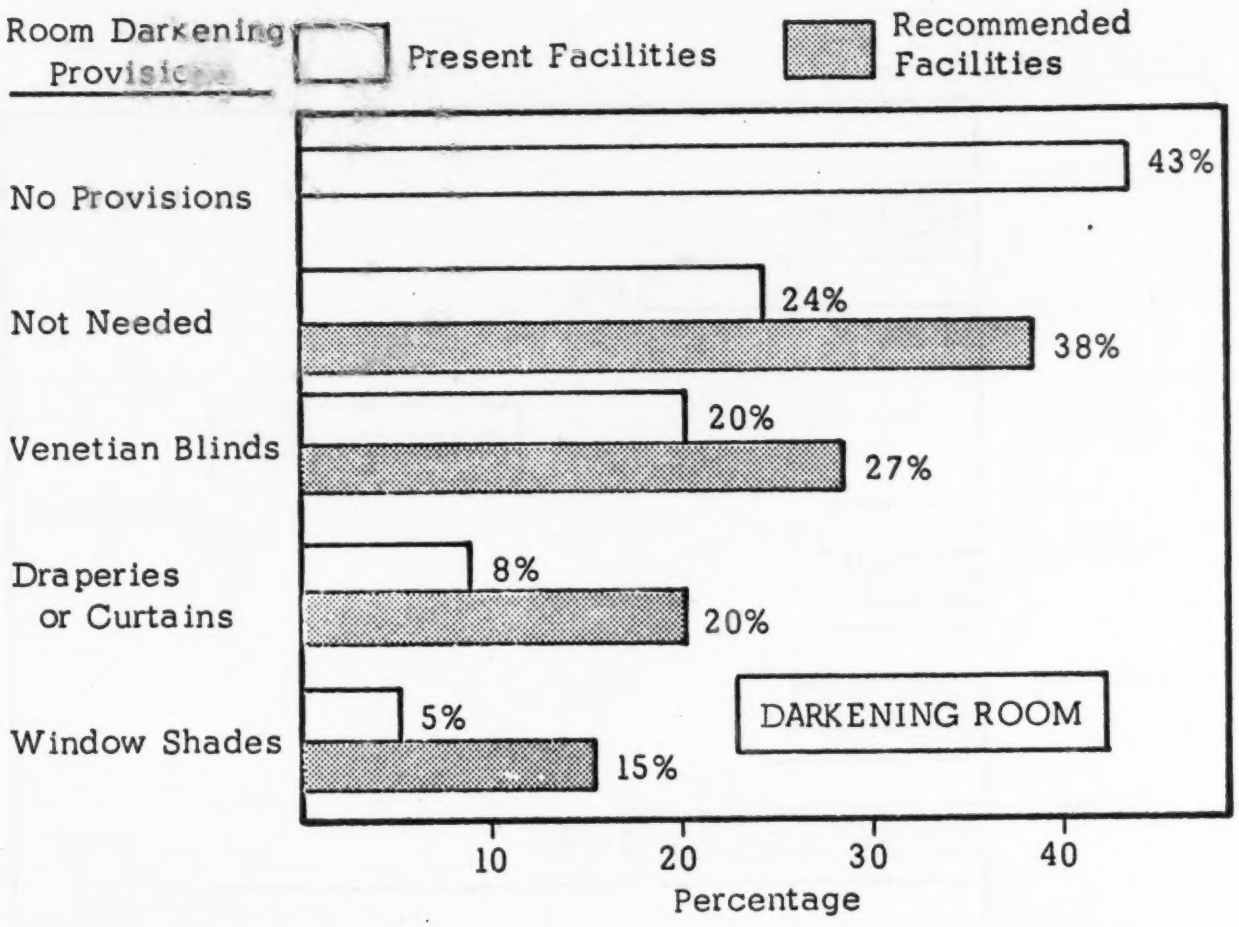


Fig. 39 --Provisions for darkening drafting rooms

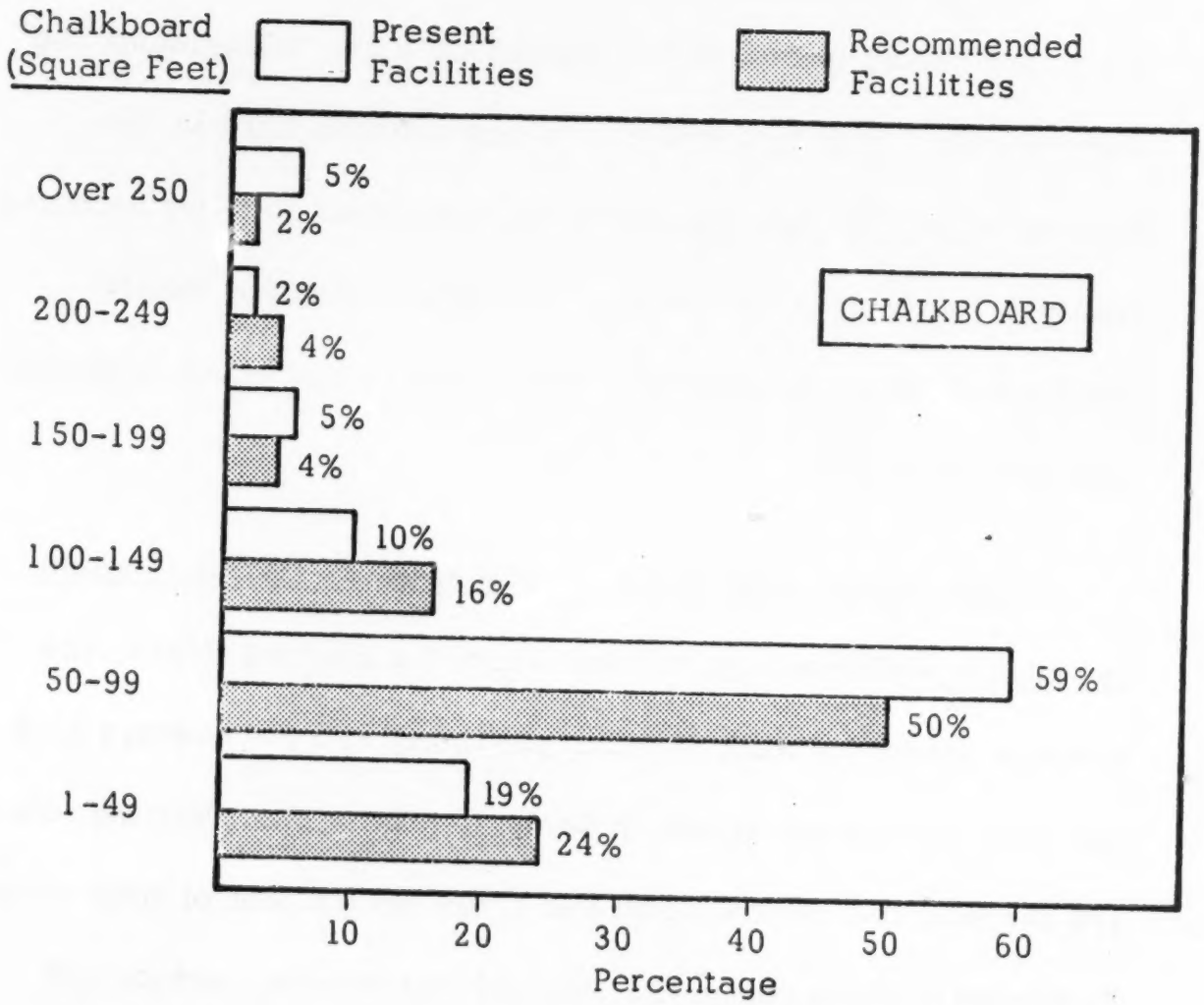


Fig. 40 -- Area of chalkboards in drafting rooms

Summary:

	Mean	Median	Range
Present Facilities:	87	69	720-24+1=697
Recommended Facilities:	87	77	300-36+1=265

Illumination.--Illumination levels of offices and drafting rooms are shown in Figure 41. Fifteen colleges (63 percent) had drafting rooms with footcandle readings between 100 and 150. Two colleges had readings above 150 and seven colleges recorded readings below 100 footcandles. Six offices had footcandle readings of 50 or less and only four colleges had office readings between 100 to 150.

Floor areas, work stations, and area per station (present facilities).--The amount of floor space for drafting rooms, the average number of work stations per room, and the average area per work station are shown in Table 17. Thirty-four drafting rooms (79 percent) had between 900 and 1,799 square feet of floor space. Forty-one drafting rooms (95 percent) had between twenty and thirty student work stations. Thirty-six drafting rooms (84 percent) had between 40 and 70 square feet of floor space for each student work area.

Floor area, work stations, and area per station (recommended facilities).--The recommended area for a drafting room, the average number of student work stations, and the average area per station are shown in Table 18. Twenty-nine

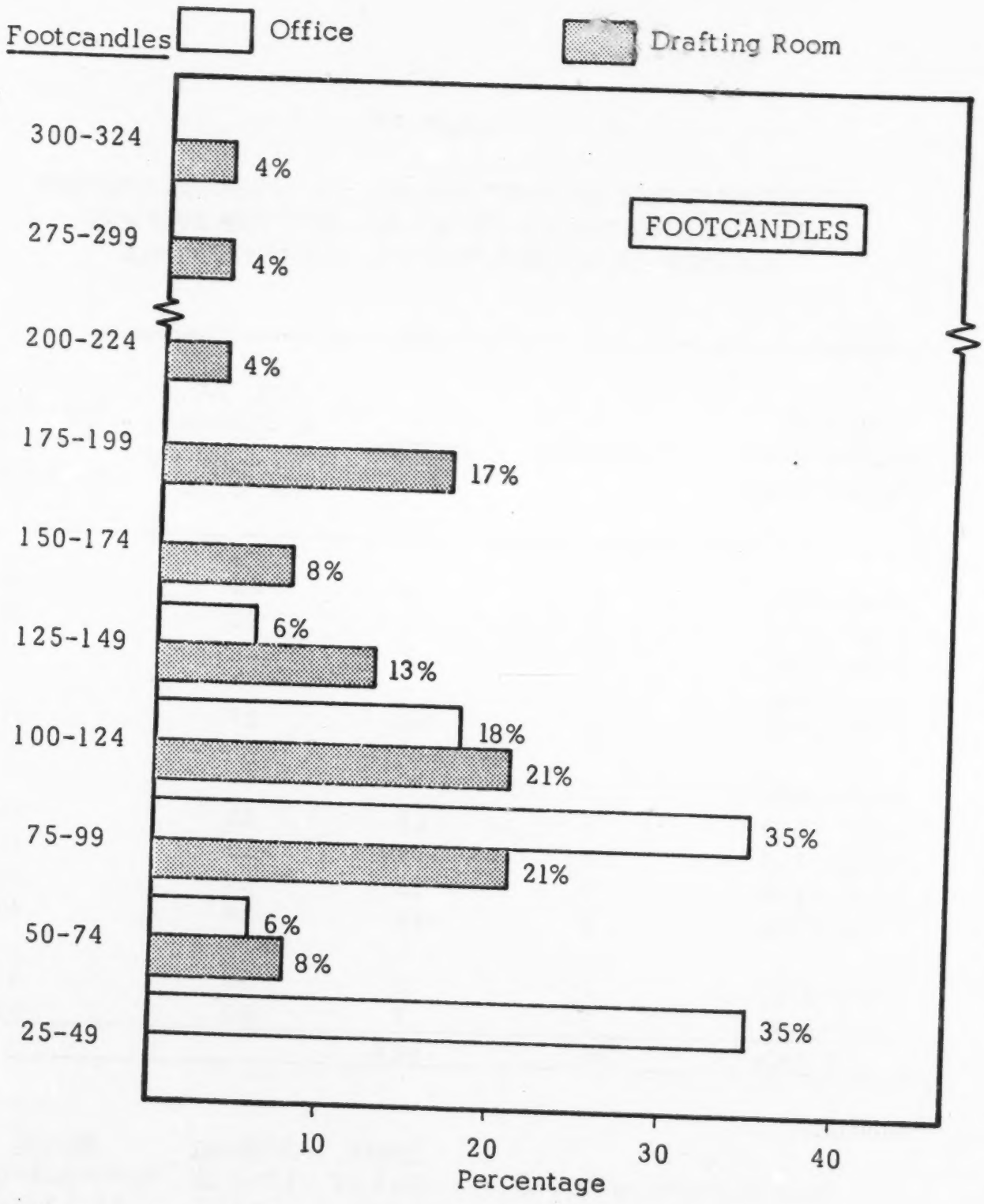


Fig. 41--Illumination levels for offices and drafting rooms

Summary:

	Mean	Median	Range
Offices:	75	81	135-23+1=113
Drafting Rooms:	142	125	323-61+1=263

TABLE 17

THE PRESENT SIZE OF DRAFTING ROOMS, AVERAGE NUMBER OF DRAFTING TABLES PER ROOM, AND THE AVERAGE NUMBER OF SQUARE FEET PER DRAFTING TABLE

Area of Drafting Room (Square Feet)	Frequency	Percent	Avg. No. of Student Work Stations Per Room	Avg. Sq. Ft. Per Student Work Station
2250-2399	1	2	23	104
2100-2249	2	5	26	86
1950-2099	1	2	26	77
1800-1949				
1650-1799	9	21	27	67
1500-1649				
1350-1499	5	12	26	57
1200-1349	8	19	23	61
1050-1199	7	15	24	49
900-1049	5	12	24	42
750-899	2	5	23	41
600-749	3	7	18	37
Totals	43	100%		

Summary:

	Mean	Median	Range
Size of Drafting Room:	1349 SF	1284 SF	2399-608+=1792
No. of Student Wk. Sta.:	24	24	32-12+1=21
No. of Square Feet per Student Work Stations:	58	51	120-27+1=94

TABLE 18

THE RECOMMENDED SIZE FOR A DRAFTING ROOM, THE RECOMMENDED NUMBER OF DRAFTING TABLES PER ROOM, AND THE RECOMMENDED NUMBER OF SQUARE FEET PER STUDENT WORK STATION

Area of Drafting Room (Square Feet)	Frequency	Percent	Avg. No. of Student Work Stations Per Room	Avg. Sq. Ft. Per Student Work Station
2850-2999	1	3	30	100
2700-2849	1	3	24	114
2550-2699	1	3	50	54
2400-2549				
2250-2399	2	5	20	120
2100-2249	1	3	26	85
1950-2099	4	10	28	74
1800-1949				
1650-1799	4	10	29	64
1500-1649	2	5	20	79
1350-1499	4	10	24	65
1200-1349	7	18	25	51
1050-1199	8	20	25	49
900-1049	1	3	20	48
750-899	3	7	18	48
Totals	39	100%		

Summary:

	Mean	Median	Range
Size of Drafting Room:	1549 SF	1368 SF	3000-768+1=2232
No. of Student Wk. Sta.:	25	24	50-15+1=36
No. of Square Feet per Student Work Station:	64	55	120-37+1=84

instructors (73 percent) recommended from 1,050 to 2,099 square feet of floor space. Thirty-five respondents (90 percent) recommended between twenty and thirty student work stations. Twenty-two instructors (56 percent) recommended between 50 and 80 square feet of floor space for each student work station. The average floor space per station was determined by dividing the total square footage of drafting room floor space by the number of student work stations. This figure, therefore, represents not only the immediate area around a student desk, but it also includes tables, storage, as well as other furnishings in a drafting room.

Laboratory Equipment

Laboratory equipment was analyzed by comparing available equipment with recommended equipment. Most of the tables and graphs in this section are followed by a summary containing the mean, median, and range.

Lettering sets.--Figure 42 shows the present and recommended number of lettering sets per drafting room. The whole or decimal numbers at the end of the bars in Figure 42 are an average of the lettering sets presently available or recommended. The numbers

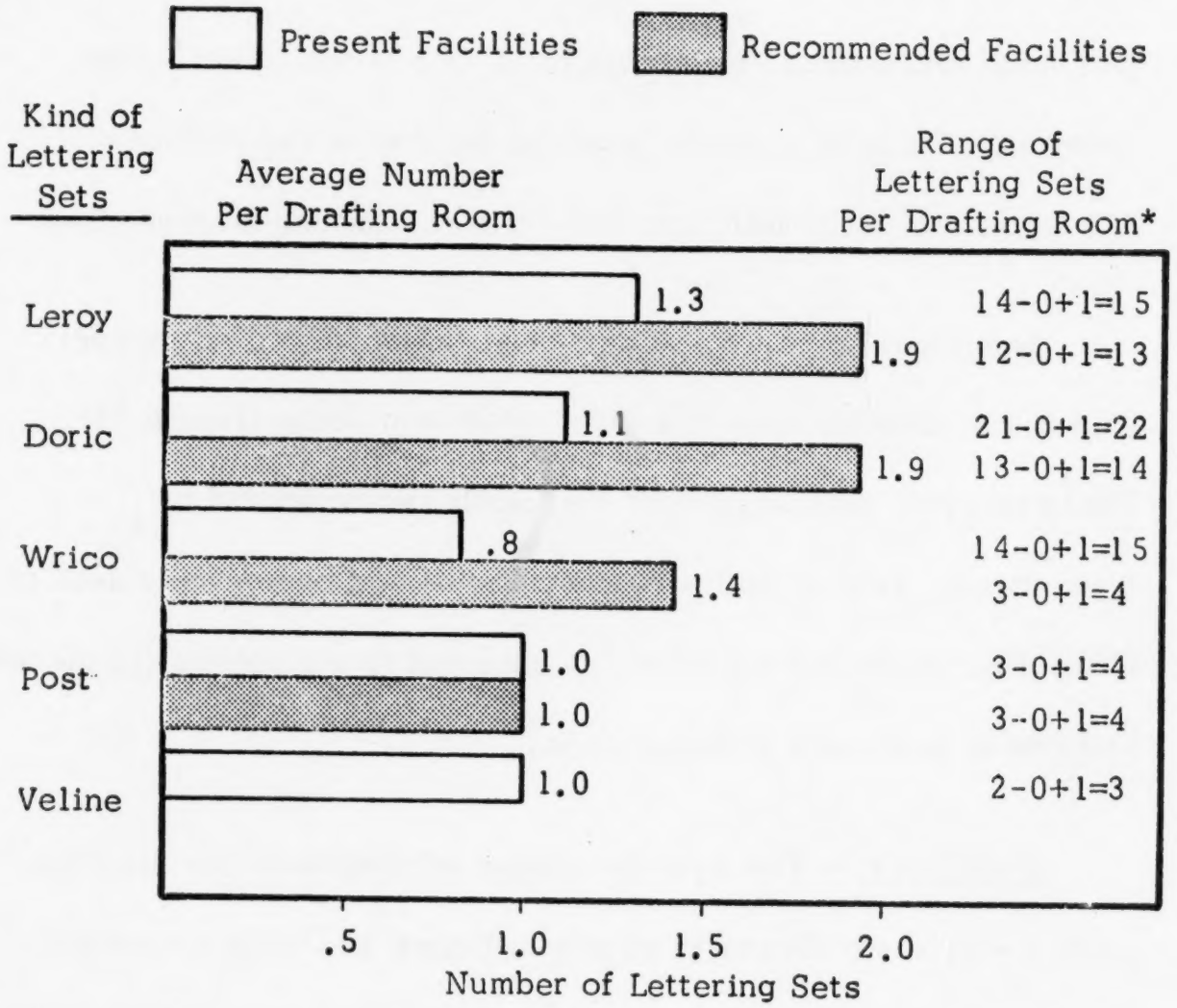


Fig. 42 --Number of lettering sets per drafting room

*The range is figured by subtracting the lowest number from the highest number of lettering sets available among the colleges. To obtain the total range, one is added to the difference.

do not necessarily indicate that colleges have, nor that drafting personnel recommend, fractional parts of a lettering set. The Leroy was the most common lettering set among the colleges. The Doric and Leroy lettering sets were recommended most often.

Technical pen sets.--The most common technical pen sets among the colleges were the Koh-I-Noor and Leroy (Figure 43). These two pen sets were most frequently recommended by instructors. Twelve colleges (52 percent) had one or more sets of Koh-I-Noor technical fountain pen sets and five colleges (19 percent) had one or more sets of Leroy pens.

Templates.--The average number of templates per drafting room among the colleges is shown in Figure 44. Data indicated that approximately two-thirds of the colleges had a majority of the templates. Generally, the smaller colleges had fewer templates than did the larger drafting programs.

Lead pointers and draftsman pencil sharpeners.--The number of lead pointers and draftsman pencil sharpeners per drafting room is shown in Figure 45. Three lead pointers were the average number available per drafting room and five were recommended by the instructors. An average of one draftsman pencil sharpener was

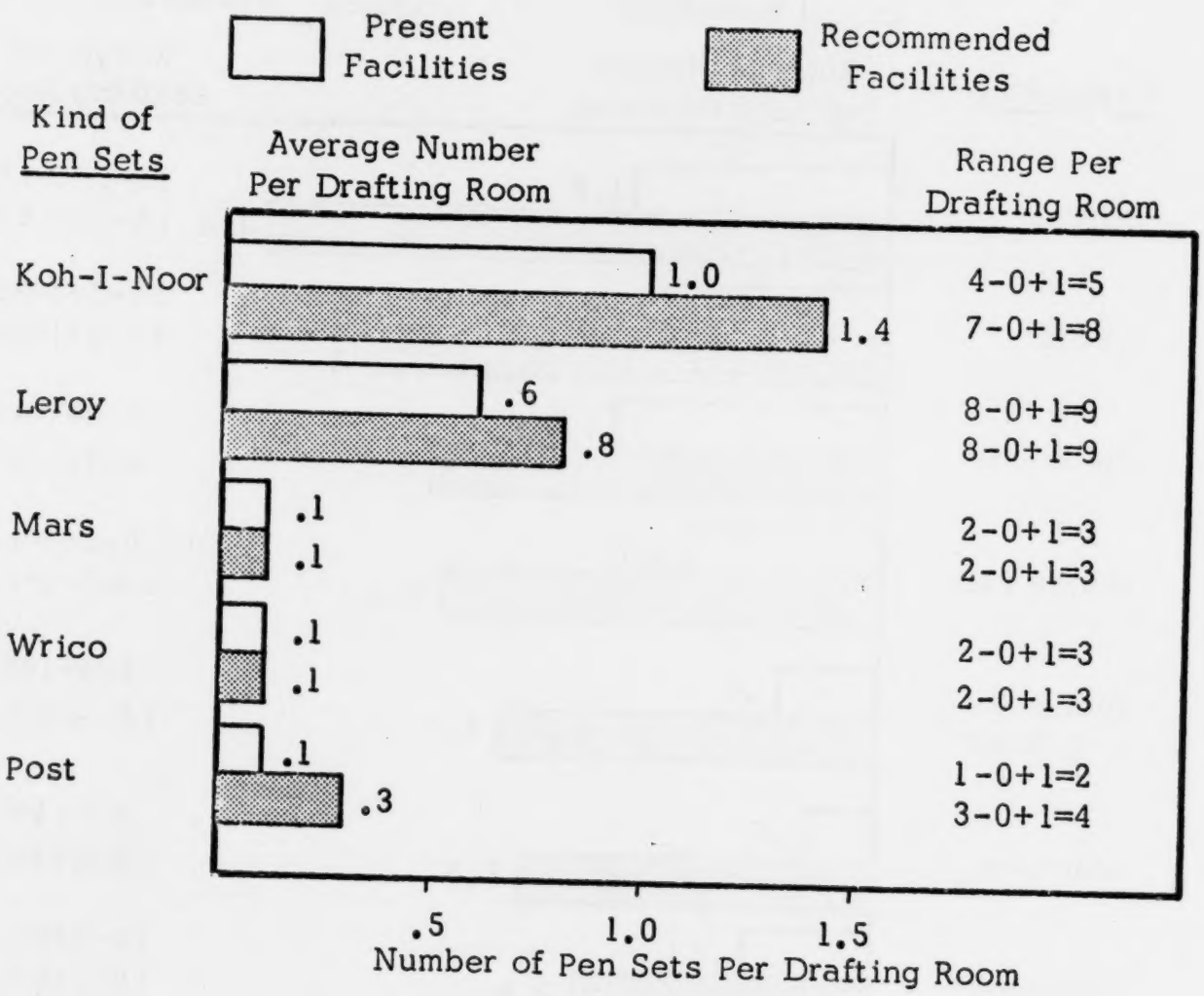


Fig. 43 --Number of pen sets per drafting room

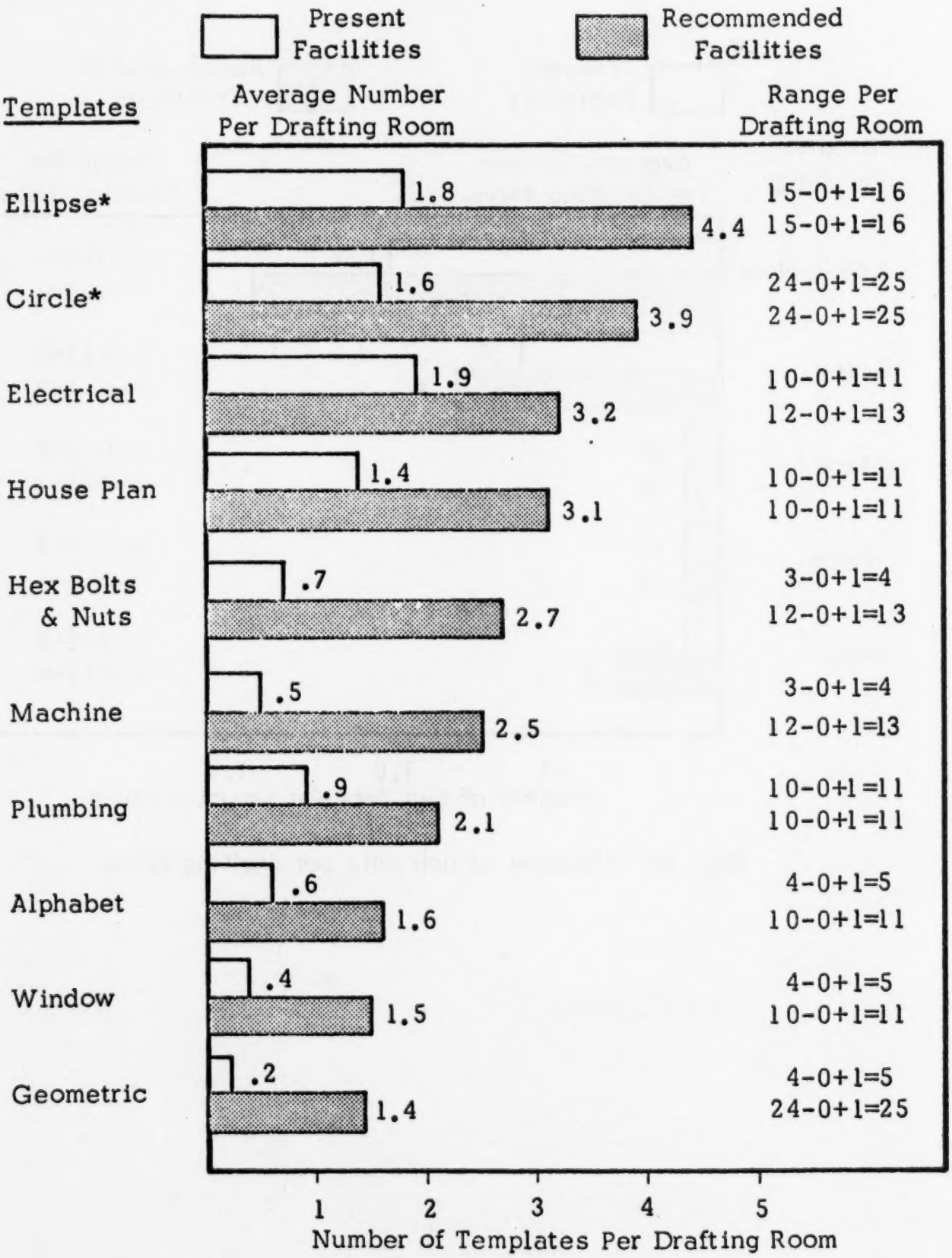


Fig. 44 --Number of templates per drafting room

*Sets of templates

Fig. 44 --Continued

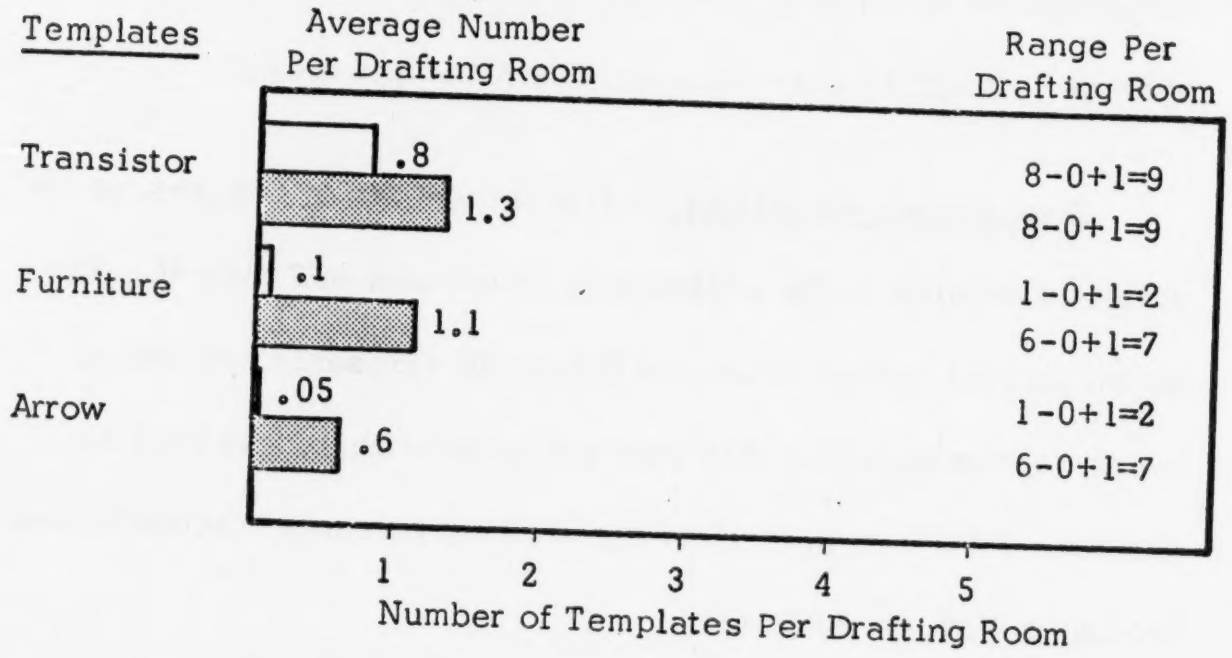


Fig. 44 --Number of templates per drafting room

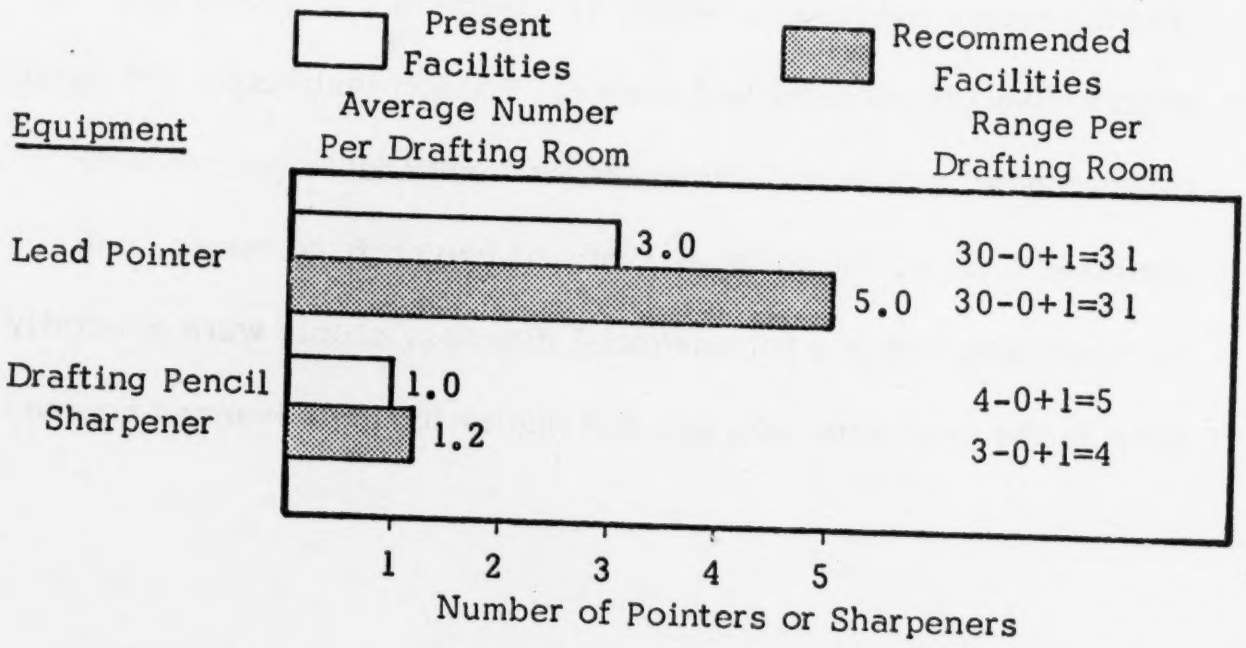


Fig. 45 --Number of lead pointers and draftsman pencil sharpeners per room

available in each drafting room. More than one sharpener was recommended by several instructors; hence, the recommended average is slightly more than one sharpener per room.

Compressed air outlets.--The percentage of compressed air outlets available in the colleges is illustrated in Figure 46. The seven percent number shown in Figure 46 epresents two out of twenty-seven colleges that were equipped with compressed air outlets. Fifty-two percent of the drafting personnel recommended facilities with air outlets.

Chairs and stools.--Figure 47 shows the percentage of the drafting rooms which had stools or chairs. Of the forty-five drafting rooms evaluated, twenty (44 percent) had stools and twenty-five (56 percent) had chairs. Sixteen instructors (36 percent) recommended stools and twenty-eight respondents (64 percent) preferred chairs. In colleges that had two drafting rooms, one for beginning and one for advanced courses, stools were generally used in the beginning courses and chairs for the advanced courses.

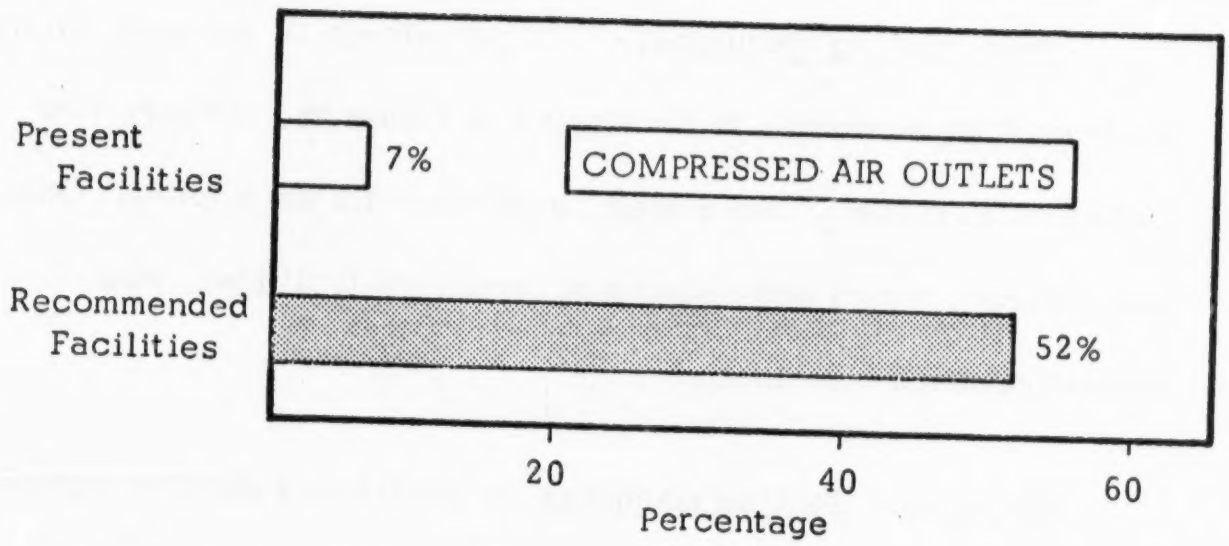


Fig. 46 --Compressed air outlets in drafting facilities

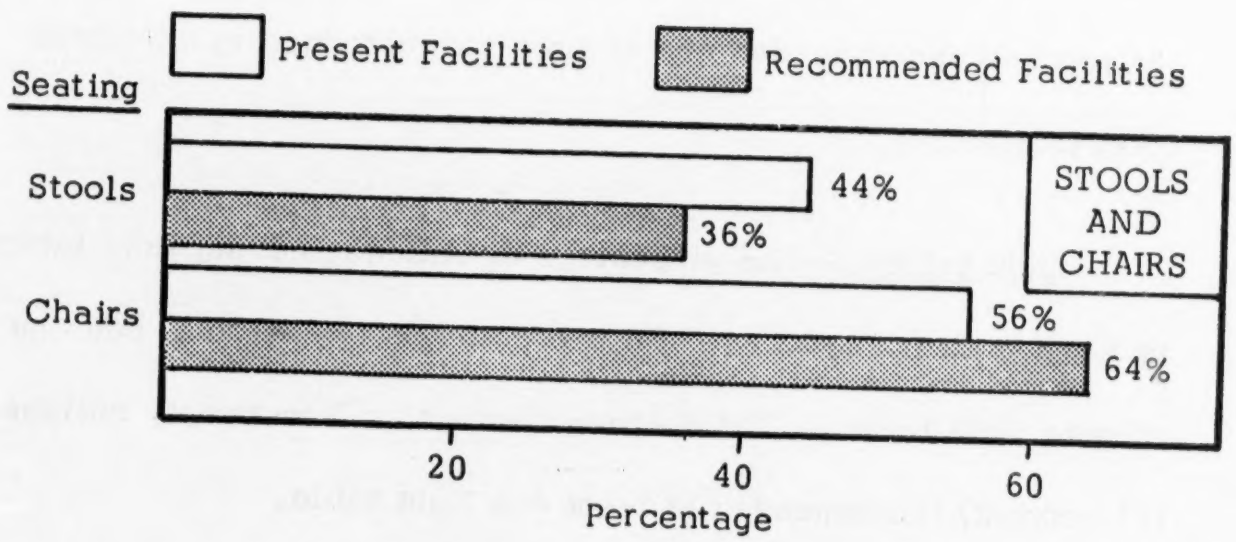


Fig. 47 --Comparison between stools and chairs in drafting facilities

Table drafting machines.--The percentage of colleges having table drafting machines is illustrated in Figure 48. Twenty-two colleges (81 percent) had a drafting machine for each table. Only one college, which was located in temporary facilities, was without drafting machines.

Chalkboard drafting machines.--Chalkboard drafting machines were available in nineteen colleges (70 percent). Figure 49 shows that instructors from twenty-two colleges (81 percent) recommended a chalkboard drafting machine.

Parallel straightedges.--The respondents from five colleges (19 percent) reported one or more parallel straightedges in their drafting rooms. The instructors from eleven different colleges (41 percent) recommended one or more straightedges in a drafting room (Figure 50).

Light tables.--The percentage of colleges having light tables is illustrated in Figure 51. Fifteen colleges (56 percent) had one or more light tables. The drafting instructors from twenty colleges (74 percent) recommended at least one light table.

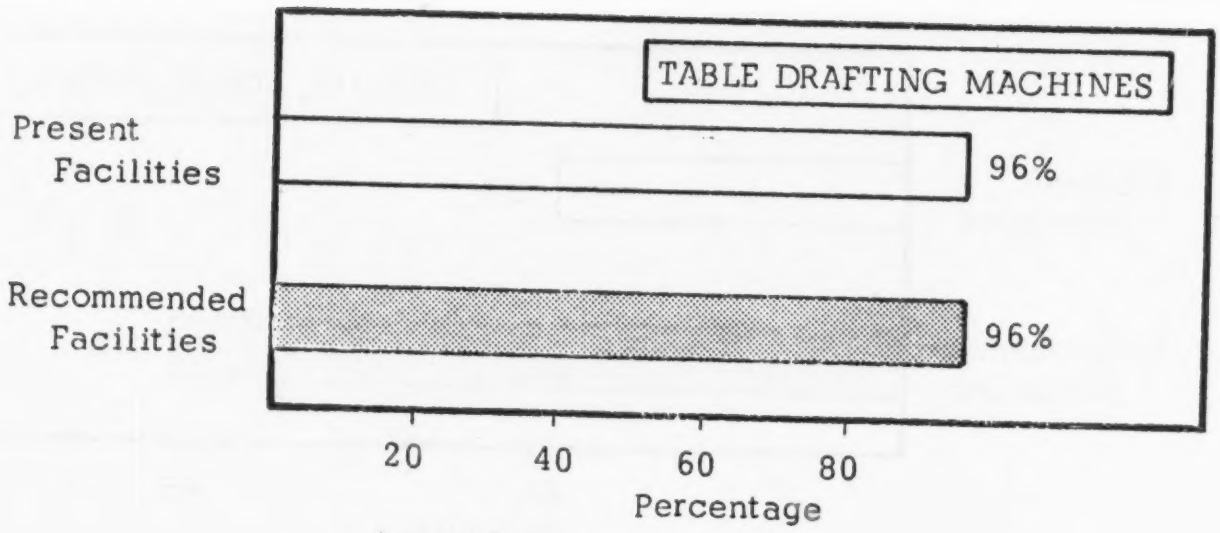


Fig. 48 --Tables equipped with drafting machines

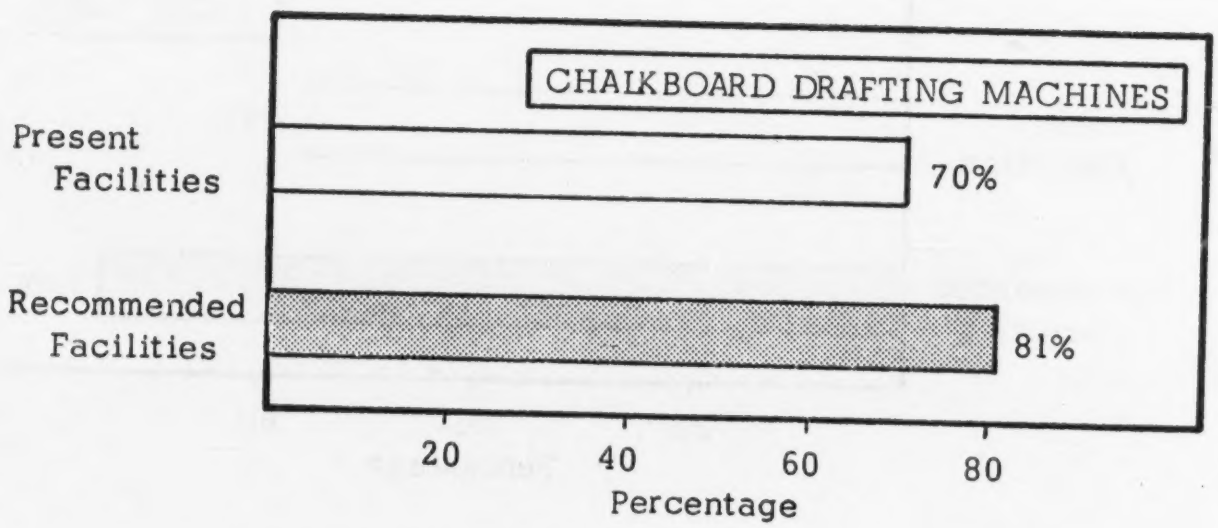


Fig. 49 --Chalkboard drafting machines in drafting facilities

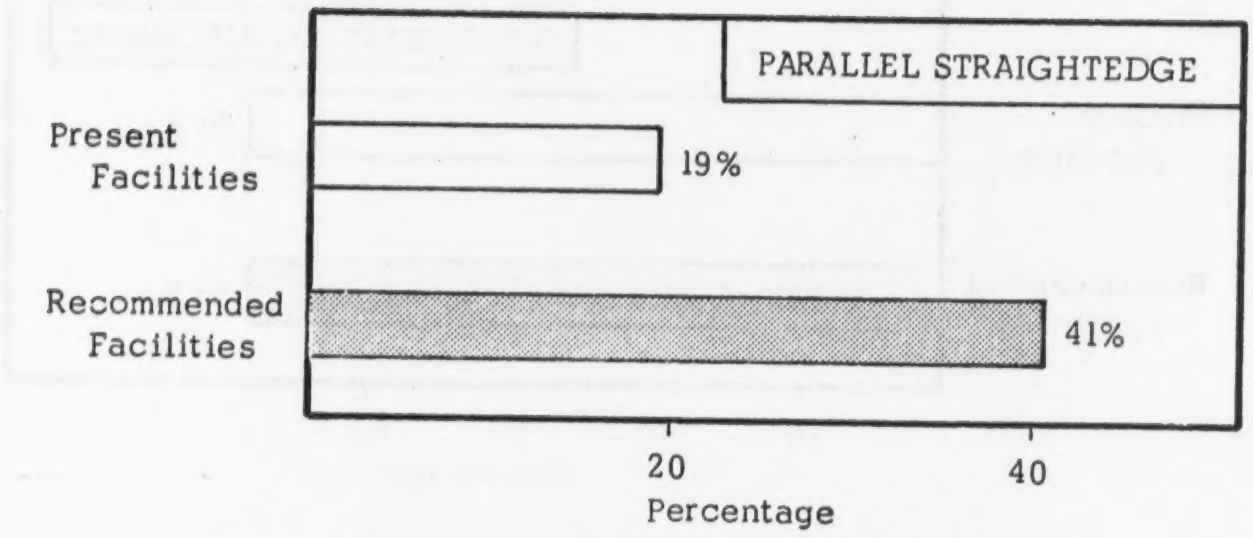


Fig. 50 --Tables equipped with parallel straightedges

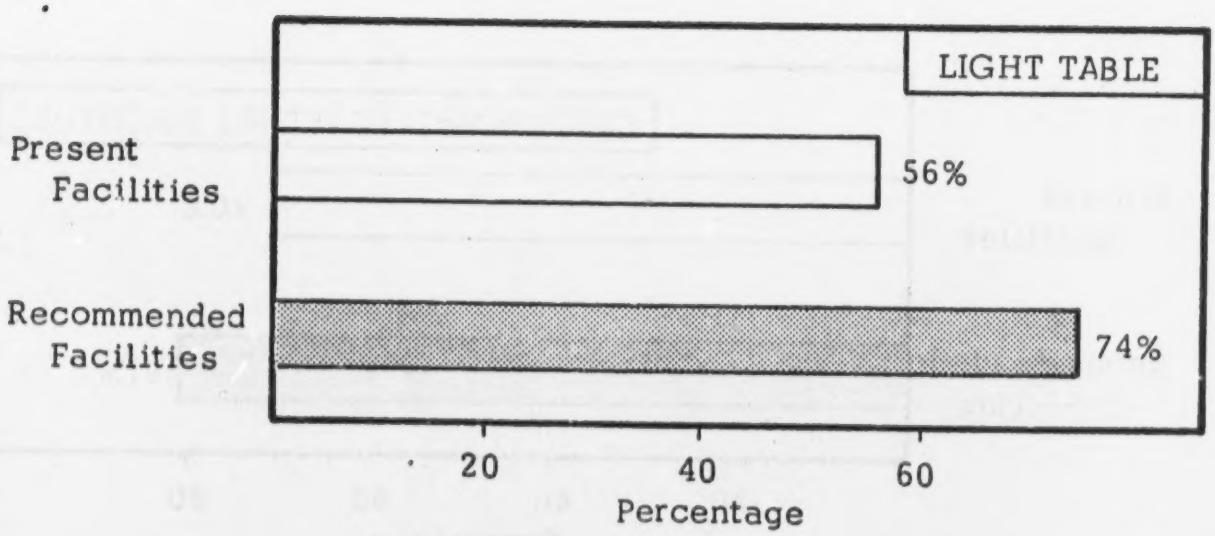


Fig. 51 --Light tables in drafting facilities

Drafting table top sizes.--The size of drafting table tops at the various colleges is shown in Table 19. The average recommended size of table tops was six inches wider than the average top available at the colleges. The most frequently reported size of drafting table top for both the present and recommended facilities was 48" wide by 36" deep.

Table 20 shows the comparison in size of table tops for colleges that had two drafting rooms -- one room for beginning and one for advanced drafting courses. The average table top size for the advanced drafting room was 18" wider and 6" deeper than the tops for the beginning courses.

Electric erasers.--Three colleges reported having ten or more electric erasers. One college had an electric eraser between each two desks throughout the drafting room.

Storage.-- Drafting facilities were investigated to determine the size, number and linear feet of present and recommended storage. The storage facilities that were examined included book cases, flat files, multi-drawer file cabinets, metal and wooden cabinets, and closets or separate rooms. The storage facilities were placed

TABLE 19

THE PRESENT AND RECOMMENDED
SIZE OF DRAFTING TABLE TOPS

Table Size	Present Facilities		Recommended Facilities	
Width Depth (inches)	Frequency	Percent	Frequency	Percent
84 X 46	1	2.4		
72 X 48	1	2.4	1	2.2
72 X 42	2	4.9		
60 X 48	1	2.4	2	4.4
72 X 36			1	2.2
60 X 42			2	4.4
60 X 40			1	2.2
72 X 30	1	2.4		
60 X 36	5	12.0	5	12.0
70 X 30	1	2.4		
50 X 40	2	4.9	3	6.6
48 X 36	7	17.0	12	26.6
54 X 30			1	2.2
44 X 36	2	4.9	3	6.6
40 X 38				
42 X 36	2	4.9	2	4.4
48 X 30			2	4.4
38 X 36			1	2.2
36 X 36			1	2.2
42 X 30	2	4.9	1	2.2
40 X 30	2	4.9	2	4.4
36 X 32	1	2.4	1	2.2
38 X 30			1	2.2
36 X 30	1	2.4	1	2.2
38 X 28	1	2.4		

TABLE 19--Continued

Table Size		Present Facilities		Recommended Facilities	
Width (inches)	Depth	Frequency	Percent	Frequency	Percent
36	X 28	2	4.9	1	2.2
38	X 26	2	4.9		
40	X 24	1	2.4		
34	X 28	1	2.4		
32	X 28	1	2.4		
36	X 24	1	2.4		
30	X 24	1	2.4		
30	X 20			1	2.2
Totals		41	100%	45	100%

Summary

	Mean (Approximate)	Median (Approximate)
Present Facilities:	42 X 36	48 X 36
Recommended Facilities:	48 X 36	48 X 36

TABLE 20

THE SIZE OF DRAFTING TABLE TOPS FOR COLLEGES HAVING ONE ROOM FOR BEGINNING DRAFTING COURSES AND ONE ROOM FOR ADVANCED COURSES*

Beginning Course		Advanced Course	
Width (inches)	Depth (inches)	Width (inches)	Depth (inches)
44	36	60	36
44	36	60	36
42	30	72	48
42	30	72	42
38	28	50	40
40	24	60	36
32	28	50	40
30	24	48	36

Summary:

	Mean (Approximate)	Median (Approximate)
Beginning Course	42 X 30	42 X 28
Advanced Course	60 X 36	60 X 36

*This table includes data from eight colleges.

into three categories according to location and use: office, drafting room, and departmental storage. The data concerning office and drafting room storage was obtained from instructors and drafting department directors from each college, but the departmental information was obtained only from directors.

In referring to the tables in this section, the column totals under "office" and "drafting room" were based on sixty-three completed or partially completed inventory forms. The column totals under "department" were based on twenty-five completed or partially completed inventory forms.

Shelving.--The linear feet of shelving reported by drafting personnel is shown in Table 21 Forty respondents (63 percent) indicated they had from one to seventy-nine linear feet of shelving in their offices and twenty-eight instructors (88 percent) recommended from ten to thirty-nine linear feet of office shelving.

Sixteen instructors (55 percent) reported from one to thirty-four linear feet of shelving in their drafting rooms. Sixteen instructors (48 percent) recommended from five to thirty-four linear feet of shelving.

The directors from six colleges (22 percent) reported having departmental shelving. One college (4 percent) had more than

TABLE 21

THE PRESENT AND RECOMMENDED LINEAR FEET OF BOOKCASE SHELVING FOR OFFICES, DRAFTING ROOMS, AND DRAFTING DEPARTMENTS

Linear Feet of Shelving	Office		Drafting Room		Department	
	Pres. No.	Rec. No.	Pres. No.	Rec. No.	Pres. No.	Rec. No.
Above 100			4	5	1	1
95 - 99			2	2		
90 - 94						
85 - 89						
80 - 84						
75 - 79	1	1				
70 - 74						
65 - 69			1			
60 - 64			2	2		1
55 - 59	2	1				
50 - 54	3	1	1	3		
45 - 49			1	2	1	
40 - 44			1	2		1
35 - 39	2	5	1	1		
30 - 34	3	1	4	2		
25 - 29	1	2		1		1
20 - 24		5	2	3	1	
15 - 19	6	6	1	1	1	1
10 - 14	14	9	4	5	1	
5 - 9	7	1	3	4	1	1
1 - 4	1		2			
0					4	1
Totals	40	32	29	33	10	7

TABLE 21--Continued

Summary:

	Mean (Linear Feet)	Median (Linear Feet)	Range (Linear Feet)
Office			
Present Facilities	21.6	12.2	80-0+1=81
Recommended Fac.	18.6	16.4	80-0+1=81
Drafting Room			
Present Facilities	42.2	30.3	180-0+1=181
Recommended Fac.	44.0	34.6	180-0+1=181
Department			
Present Facilities	21.3	5.5	156-0+1=157
Recommended Fac.	36.7	25.1	156-0+1=157

one hundred linear feet of shelving and four colleges (15 percent) had less than twenty-four linear feet. Four drafting directors (15 percent) recommended five to forty-four linear feet of shelving.

Flat files.--The present and recommended size and number of flat file cabinets for offices, drafting rooms, and drafting departments are shown in Table 22. Eight out of sixty-three instructors indicated they had flat files in their offices and seventeen instructors (27 percent) recommended flat file cabinets for an office. The two most frequently recommended sizes for flat files were 30" wide by 24" deep by 50" high and 48" wide by 36" deep by 16" high.

Fourteen colleges (52 percent) had flat files in their drafting rooms. The drafting personnel from twenty-two colleges (81 percent) recommended flat files in drafting rooms.

Five colleges (19 percent) had departmental flat files. The directors from seven colleges (26 percent) suggested flat files for departmental use.

Letter-size files.--The present and recommended number of letter-size file cabinets for offices, drafting rooms, and drafting departments is displayed in Table 23. Thirty respondents (65 percent)

TABLE 22

NUMBER OF FLAT FILES IN OFFICES, DRAFTING ROOMS, AND DEPARTMENTS

Dimensions (inches) W D H	Office		Drafting Room		Department	
	Pres. No.	Rec. No.	Pres. No.	Rec. No.	Pres. No.	Rec. No.
72 X 24 X 84			3	3		
72 X 24 X 42			1	1		
60 X 60 X 48		4				
55 X 45 X 36			11	10		
54 X 42 X 60			1			
48 X 48 X 36			1	1		
48 X 42 X 36			1	2		
48 X 42 X 24			4	5		
48 X 36 X 24			1	2		
48 X 36 X 60		1				
48 X 36 X 48	1	3				
48 X 36 X 36	1	3				1
48 X 36 X 24						
48 X 36 X 16	5	8				
48 X 35 X 48			4	2		
48 X 32 X 36	2	1				
46 X 35 X 48						
46 X 24 X 42					1	1
43 X 36 X 32			1	1		
42 X 30 X 15				1		
42 X 24 X 18					1	5
40 X 30 X 72			1	1		
37 X 26 X 24			12	12		
36 X 48 X 36			1	12		
36 X 36 X 30			1			

TABLE 22--Continued

Dimensions (inches) W D H	Office		Drafting Room		Department	
	Pres. No.	Rec. No.	Pres. No.	Rec. No.	Pres. No.	Rec. No.
36 X 30 X 24			1	1		
36 X 24 X 36		2				
36 X 24 X 24				4		
36 X 12 X 60			3	5		
34 X 33 X 15	2	3				
33 X 25 X 40			1	2		
30 X 42 X 72				2		
30 X 40 X 18	1	2				
30 X 24 X 50	4	5				
30 X 24 X 60			3	3		
24 X 36 X 72				4		
24 X 36 X 48						1
24 X 24 X 48					33	33
15 X 24 X 60	1	2				
Totals	17	35	42	74	35	41

Summary:

	Dimensions (mode)	
	Present Facilities (inches) W D H	Recommended Facilities (inches) W D H
Office:	48 X 36 X 16	48 X 36 X 16
Drafting Room:	37 X 26 X 24	37 X 26 X 24
Department:	24 X 24 X 48	24 X 24 X 48

TABLE 23

NUMBER OF LETTER-SIZE FILE CABINETS FOR OFFICES, DRAFTING ROOMS, AND DEPARTMENTS

Number of Files	Office		Drafting Room		Department	
	Pres. No.	Rec. No.	Pres. No.	Rec. No.	Pres. No.	Rec. No.
4		1	1	2		4
3		2	2	2		3
2	9	2	3	3	4	5
1	21	18	2	8	2	2
0	16	18	42	28		
Totals	46	41	50	43	6	14

Summary:

	Mean	Median	Range
Office			
Present Facilities	.85	1	2-0+1=3
Recommended Facilities	.78	1	4-0+1=5
Drafting Room			
Present Facilities	.31	0	4-0+1=5
Recommended Facilities	.65	0	4-0+1=5
Department			
Present Facilities	1.66	2	2-0+1=3
Recommended Facilities	2.64	2	4-0+1=5

indicated from one to two files in their offices. Eighteen respondents (44 percent) recommended one letter-size file cabinet for offices. Of those who recommended letter-size cabinets, five respondents (12 percent) suggested from two to four files.

Eight instructors (16 percent) stated they had at least one letter-size file cabinet in their drafting room. Table 23 shows that fifteen instructors (35 percent) recommended one or more letter-size cabinets for a drafting room.

The number of departments having letter-size file cabinets was six (22 percent). Table 23 shows that fourteen departmental directors (52 percent) recommended one to four letter-size file cabinets.

Legal-size files.--The present and recommended number of legal-size file cabinets for offices, drafting rooms, and departments is shown in Table 24. Twenty-three instructors (56 percent) stated they had one or more legal-size file cabinets in their office and twenty-seven instructors (75 percent) recommended one or more cabinets.

Table 24 shows that three drafting rooms (7 percent) had one legal-size file cabinet. Eleven instructors (30 percent) recommended one or more cabinets.

TABLE 24

NUMBER OF LEGAL-SIZE FILE CABINETS FOR OFFICES, DRAFTING ROOMS, AND DEPARTMENTS

Number of Files	Office		Drafting Room		Department	
	Pres. No.	Rec. No.	Pres. No.	Rec. No.	Pres. No.	Rec. No.
5		1		1		
4	1	1			1	1
3	2		1	1		
2	2	10		4		1
1	18	15	3	5	1	4
0	18	9	40	27	9	4
Totals	41	36	44	37	11	10

Summary:

	Mean	Median	Range
Office			
Present Facilities	.78	0	4-0+1=5
Recommended Facilities	1.22	1	5-0+1=6
Drafting Room			
Present Facilities	.14	0	3-0+1=4
Recommended Facilities	.58	0	6-0+1=7
Department			
Present Facilities	.70	0	4-0+1=5
Recommended Facilities	1.00	1	4-0+1=5

Two drafting directors (7 percent) indicated they had one or more legal-size file cabinets for departmental use. Six directors (22 percent) recommended one or more legal-size files.

Metal cabinets.--The present and recommended number of metal cabinets for offices, drafting rooms, and departments are shown in Table 25. Thirteen instructors out of sixty-three (20 percent) indicated they had a metal cabinet in their office. The largest available cabinet was 52.5 cubic feet and the smallest cabinet was 5.8 cubic feet. The largest recommended metal cabinet for office use was 48 cubic feet and the smallest suggested cabinet was 12 cubic feet.

Four instructors (6 percent) stated they had metal cabinets in their drafting rooms. The largest metal cabinet reported was 36 cubic feet and the smallest was 23.3 cubic feet. Five instructors (8 percent) recommended a metal cabinet for drafting rooms. The largest cabinet recommended for drafting rooms was 36 cubic feet and the smallest size was 18 cubic feet.

Table 25 shows that five directors (19 percent) reported having metal cabinets for departmental storage. The largest size of cabinet reported for both present and recommended facilities

TABLE 25

NUMBER OF METAL CABINETS FOR OFFICES, DRAFTING ROOMS, AND DEPARTMENTS

Dimensions (inches) W D H	Office		Drafting Room		Department	
	Pres. No.	Rec. No.	Pres. No.	Rec. No.	Pres. No.	Rec. No.
62 X 20 X 30	1	1				
48 X 24 X 72	2	4				
48 X 12 X 72	1					
36 X 36 X 48			1	1		
36 X 30 X 84	1					
36 X 24 X 84	1	3				
36 X 24 X 72	1	1				
36 X 24 X 24		1				
36 X 18 X 72	3	1	1	1		
36 X 14 X 80			2	2		
36 X 12 X 84					4	5
30 X 17 X 36					1	1
24 X 36 X 36				1		
24 X 18 X 30	2					
21 X 16 X 30	1					
Totals	13	11	4	5	5	6

Summary:

	Dimensions (mode) Width		Depth		Height
Office					
Present Facilities	36	X	18	X	72
Recommended Facilites	48	X	24	X	72

TABLE 25--Continued

Summary:

	Dimensions (mode)		
	Width	Depth	Height
Drafting Room			
Present Facilities	36 X	14 X	80
Recommended Facilities	36 X	14 X	80
Department			
Present Facilities	36 X	12 X	84
Recommended Facilities	36 X	12 X	84

was 21 cubic feet and the smallest was 10.6 cubic feet. Six directors (22 percent) recommended one or more metal cabinets for departmental storage.

Wooden cabinets.--Table 26 illustrates the various sizes of wooden cabinets that were present and recommended for offices, drafting rooms, and departments. Fifteen respondents (24 percent) stated they had a wooden cabinet in their office. The largest cabinet reported was 112 cubic feet and the smallest was 7 cubic feet. The largest recommended cabinet for an office was 68.4 cubic feet and the smallest was 7 cubic feet.

The drafting room was the most frequent location of wooden cabinets. The largest wooden cabinet in a drafting room was 112 cubic feet and the smallest cabinet was 3.9 cubic feet. The largest and smallest recommended cabinets were the same as those reported for present facilities.

Four directors (15 percent) reported they had wooden cabinets for departmental storage. The largest size was 64 cubic feet and the smallest size was 3 cubic feet. The same size range was also recommended for departmental storage.

TABLE 26

NUMBER OF WOODEN CABINETS FOR OFFICES, DRAFTING ROOMS, AND DEPARTMENTS

Dimensions (inches) W D H	Office		Drawing Room		Department	
	Pres. No.	Rec. No.	Pres. No.	Rec. No.	Pres. No.	Rec. No.
144 X 24 X 42			1			
102 X 15 X 36	1	1				
96 X 36 X 24			2	2		
96 X 24 X 84	1		1	2		
72 X 18 X 36	1	1				
72 X 14 X 48			1	1		
60 X 24 X 96			6	6		
60 X 24 X 84			3	2		
60 X 14 X 30						
60 X 12 X 84			3	5		
48 X 30 X 96			1	1		
48 X 24 X 96					2	2
48 X 24 X 72			1			
48 X 22 X 84	1	1	4	2		
48 X 12 X 48			1	1		
48 X 12 X 36	2		2	2		
36 X 12 X 108			2	2		
36 X 24 X 96			10	10		
30 X 30 X 84			2	2		
24 X 24 X 96	8	8				
24 X 24 X 48				2		
24 X 12 X 42	1	2				
16 X 24 X 30			1			
12 X 24 X 36					1	
12 X 18 X 42			1			

TABLE 26--Continued

Dimensions (inches) W D H	Office		Drafting Room		Department	
	Pres. No.	Rec. No.	Pres. No.	Rec. No.	Pres. No.	Rec. No.
12 X 12 X 36					1	1
11X 17 X 36			20	25		
Totals	15	13	62	65	4	3

Summary:

	Dimensions (mode) W D H
Office	
Present Facilities	24 X 24 X 96
Recommended Facilities	24 X 24 X 96
Drafting Room	
Present Facilities	11 X 17 X 36
Recommended Facilities	11 X 17 X 36
Department	
Present Facilities	48 X 30 X 96
Recommended Facilities	48 X 30 X 96

Closets or separate rooms.--The present and recommended number of closets or separate rooms in offices, drafting rooms, and departments are illustrated in Table 27. Nineteen respondents (46 percent) indicated they had from 1 to 224 square feet of closet or separate room space and seven instructors (63 percent) recommended from 1 to 224 square feet.

Twenty four instructors (55 percent) reported from 25 to 324 square feet of storage in a separate room joining the drafting room. Thirty-three respondents (70 percent) recommended from 25 to 324 square feet of closet or separate room storage for work associated with the drafting room.

The present and recommended number of closets or separate rooms for departmental storage is shown in Table 27. Five directors (19 percent) stated they had storage for departmental materials and four directors (15 percent) recommended a special room for departmental storage.

General need for storage.--Figure 52 shows the percentage of drafting directors who indicated they needed additional facilities for storage. This figure reflects the general attitude of the directors concerning their storage facilities and is not intended to pinpoint specific storage needs.

TABLE 27

NUMBER OF CLOSETS OR SEPARATE ROOMS IN OFFICES, DRAFTING ROOMS, AND DEPARTMENTS

Size of Room (Square Feet)	Office		Drafting Room		Department	
	Pres. No.	Rec. No.	Pres. No.	Rec. No.	Pres. No.	Rec. No.
475 - 499	1	1	1	1		
450 - 474						
425 - 449	1					
400 - 424			1	1	2	1
375 - 399						
350 - 374						
325 - 349						
300 - 324			7	5		
275 - 299						
250 - 274						
225 - 249						
200 - 224	2	4	3	4		
175 - 199			5	2		
150 - 174	2	2	2	2		
125 - 149	1	2	3	4		
100 - 124			1	4	2	2
75 - 99	3	5		2		
50 - 74	1	1	1	3		1
25 - 49	2	1	2	7	1	
1 - 24	8	12		1		
0	20	15	18	11	1	
Totals	41	43	44	47	6	4

TABLE 27--Continued

Summary:

	Mean	Median	Range
Office			
Present Facilities	56	2	499-0+1=500
Recommended Facilities	51	14	499-0+1=500
Drafting Room			
Present Facilities	118	125	450-0+1=451
Recommended Facilities	137	93	450-0+1=451
Department			
Present Facilities	181	112	410-0+1=411
Recommended Facilities	175	112	400-0+1=401

Storage

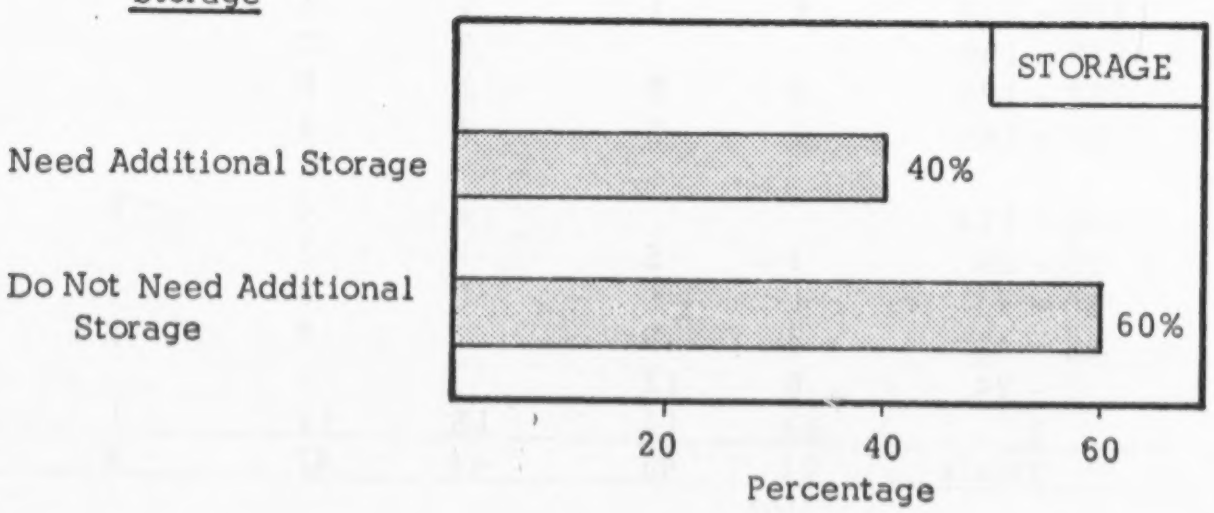


Fig. 52 --Need for additional storage in drafting facilities

Audiovisual & Reproduction Equipment.--An investigation was made to determine the present and recommended average number of audio-visual and reproduction machines for each drafting room and teacher (Table 28). The numbers in the table were based on forty-five drafting rooms and seventy-eight drafting personnel.

Most common equipment and machines.--Data indicated overhead projectors were the most common instructional machines in drafting departments and paper cutters were the most common equipment. The dry diazo reproduction machine was the most common among the colleges.

The microfilming camera, 35 mm camera, and 8 mm projector showed the largest percentage increase from present to recommended facilities. A public address system was recommended by a lower percentage of drafting personnel than was other equipment.

Projection screens.--The percentage of drafting departments that had beaded and matte projection screens is shown in Figure 53 .

TABLE 28

PRESENT AND RECOMMENDED NUMBER OF AUDIO-VISUAL AND REPRODUCTION EQUIPMENT

Equipment	Present Facilities		Recommended Facilities	
	Avg. No. Per Drafting Room	Average No. Per Teacher	Avg. No. Per Drafting Room	Average No. Per Teacher
16mm Projector	.64	.41	.73	.42
8mm Projector	.15	.05	.55	.19
Overhead Projector	1.00	.59	1.13	.65
Film Strip Projector	.48	.28	.69	.40
Slide Projector	.48	.28	.69	.40
Opaque Projector	.29	.17	.51	.29
T.V. Monitor	.06	.04	.31	.18
T.V. Camera	.06	.04	.18	.10
Tape Recorder	.38	.22	.56	.32
Record Player	.22	.13	.40	.23
35mm Camera	.09	.05	.49	.28
35mm Copy Stand	.11	.06	.53	.31
Moist Diazo	.13	.08	.27	.15
Dry Diazo	.47	.27	.60	.35
Micro-filming Camera	.02	.01	.62	.36
Micro-filming Reader	.09	.05	.33	.19
Blueprint Machine	.16	.09	.27	.15
Public Address System	.18	.10	.16	.09
Ditto Machine	.44	.26	.53	.31
Mimeograph Machine	.42	.24	.47	.27
Thermo-Fax	.40	.23	.53	.31
Xerox	.31	.18	.49	.28
Paper Cutter	.76	.44	.98	.56

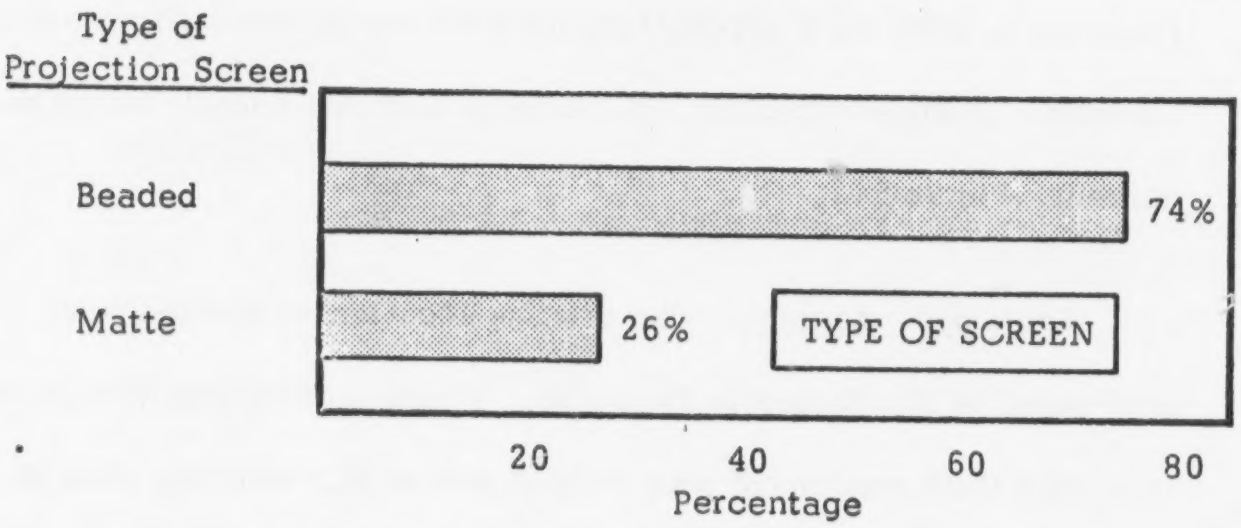


Fig. 53 --Type of projection screens in drafting rooms

Fourteen directors (74 percent) indicated they had beaded projection screens. Thirteen directors (59 percent) had permanently mounted screens (Figure 54).

Equipment storage.--The storage location of audio-visual equipment is illustrated in Figure 55. Fourteen directors (64 percent) indicated their equipment was located either in a drafting room or in the building where the drafting department was located, and eight directors (36 percent) reported their equipment was centrally located on the college campus, generally in the college library.

Figure 56 shows the percentage of directors who were of the opinion their audio-visual equipment was easily accessible. Sixteen directors (76 percent) indicated their equipment was conveniently located.

Administrative facilities include the various aspects of an office such as location, size, and equipment. A table and several figures are used in this section to provide a quick summary of the data.

Private office.--Figure 57 shows the percentages of drafting personnel who had and recommended a private office. Thirty-seven

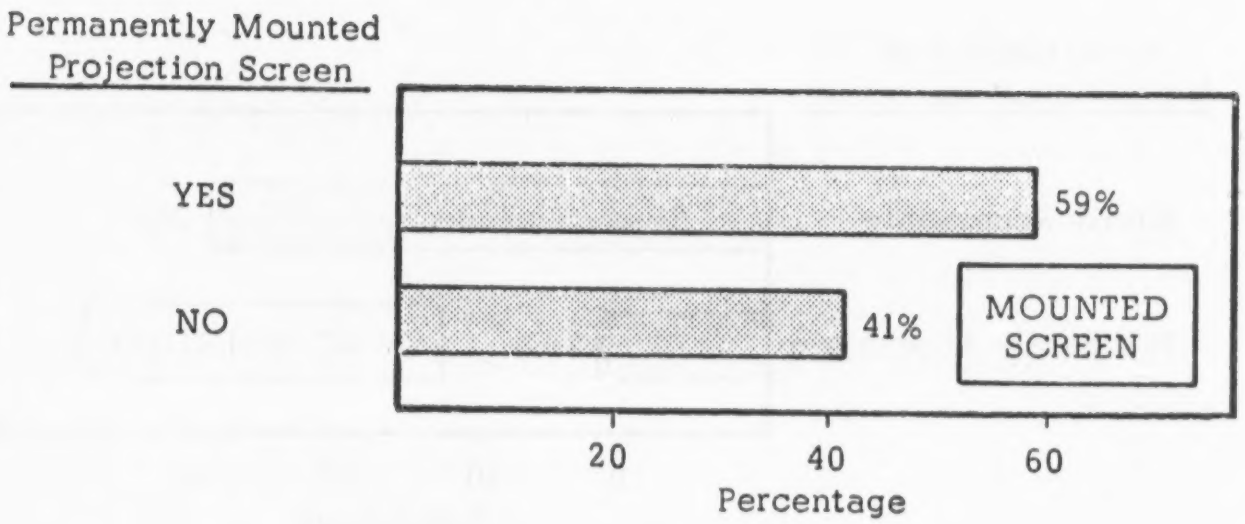


Fig. 54 --Projection screens that were permanently mounted in drafting rooms

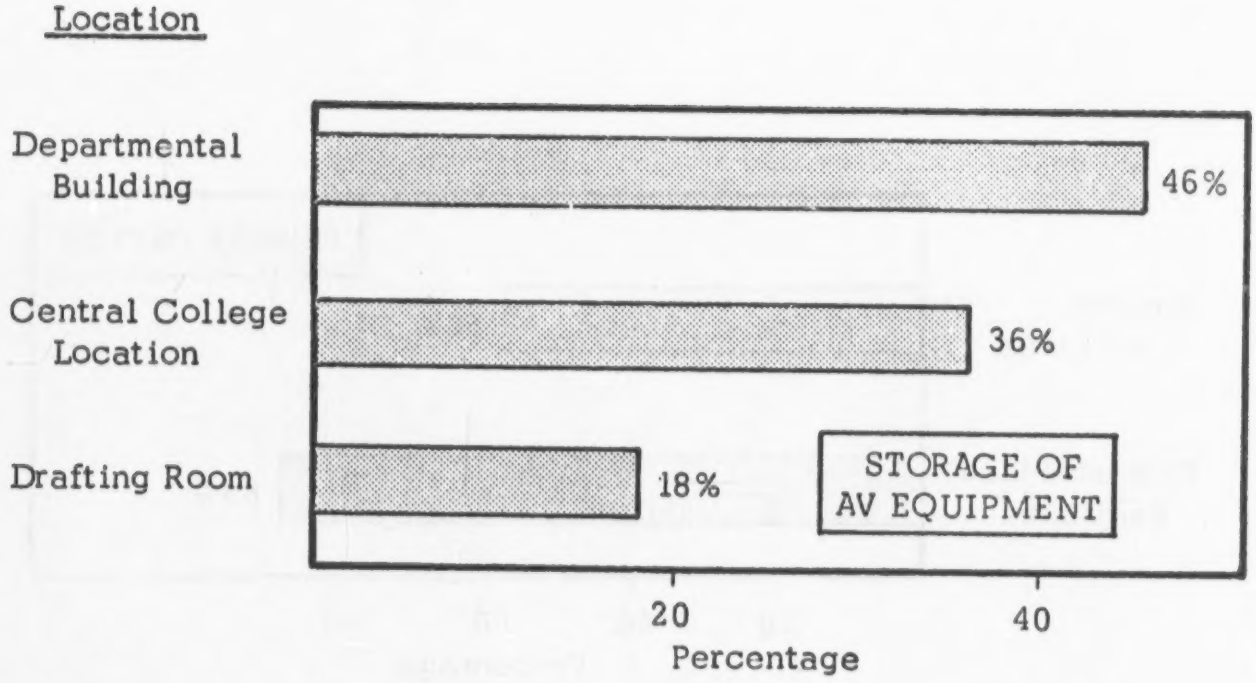


Fig. 55--Locations for storage of audio-visual equipment

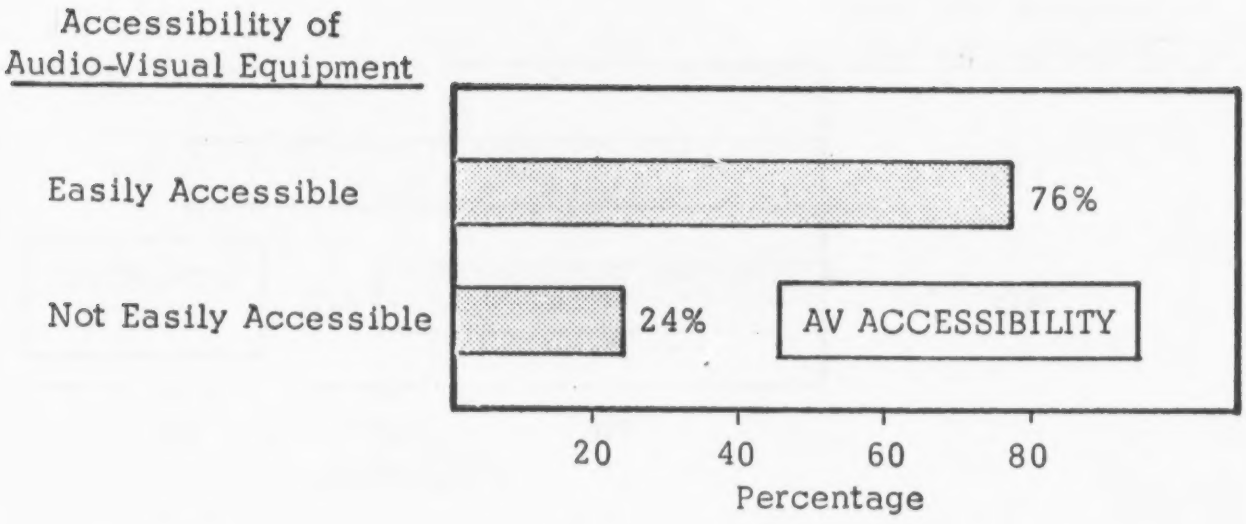


Fig. 56 --Accessibility of audio-visual equipment storage

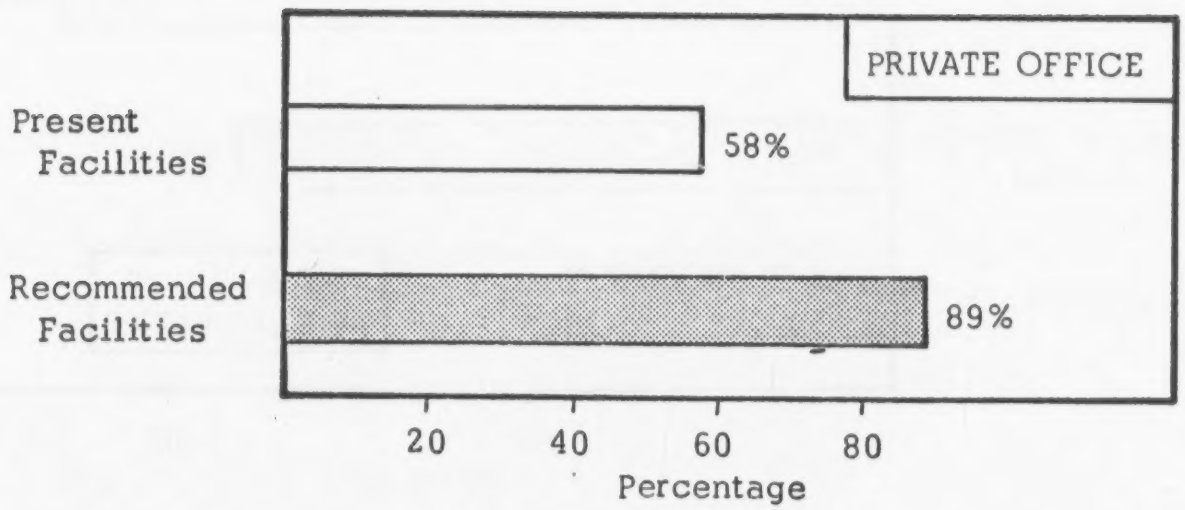


Fig. 57 --Private offices in drafting facilities

respondents (58 percent) reported they had a private office and fifty-one instructors (89 percent) recommended a private office.

Shared office.--Figure 58 shows a percentage breakdown of the twenty-seven instructors (42 percent) who shared an office The figure shows the percentage that shared with one or more people. Eleven respondents (58 percent) indicated they shared with one person and three people (16 percent) shared with four instructors.

Office location.--The present and recommended location of the offices is shown in Figure 59. Thirty-two respondents stated their office was next to the drafting room and nineteen people (33 percent) indicated their office was centrally located with other instructors. Twenty-nine drafting people (66 percent) recommended that offices be located next to the drafting room.

Office size.-- The present and recommended floor area of offices is shown in Table 29. Offices that were shared were divided by the number of instructors in the office to determine the square footage per each person. Twenty-eight offices (56 percent) had from 90 to 149 square feet of floor space. Seventeen respondents (56 percent) recommended from 120 to 149 square

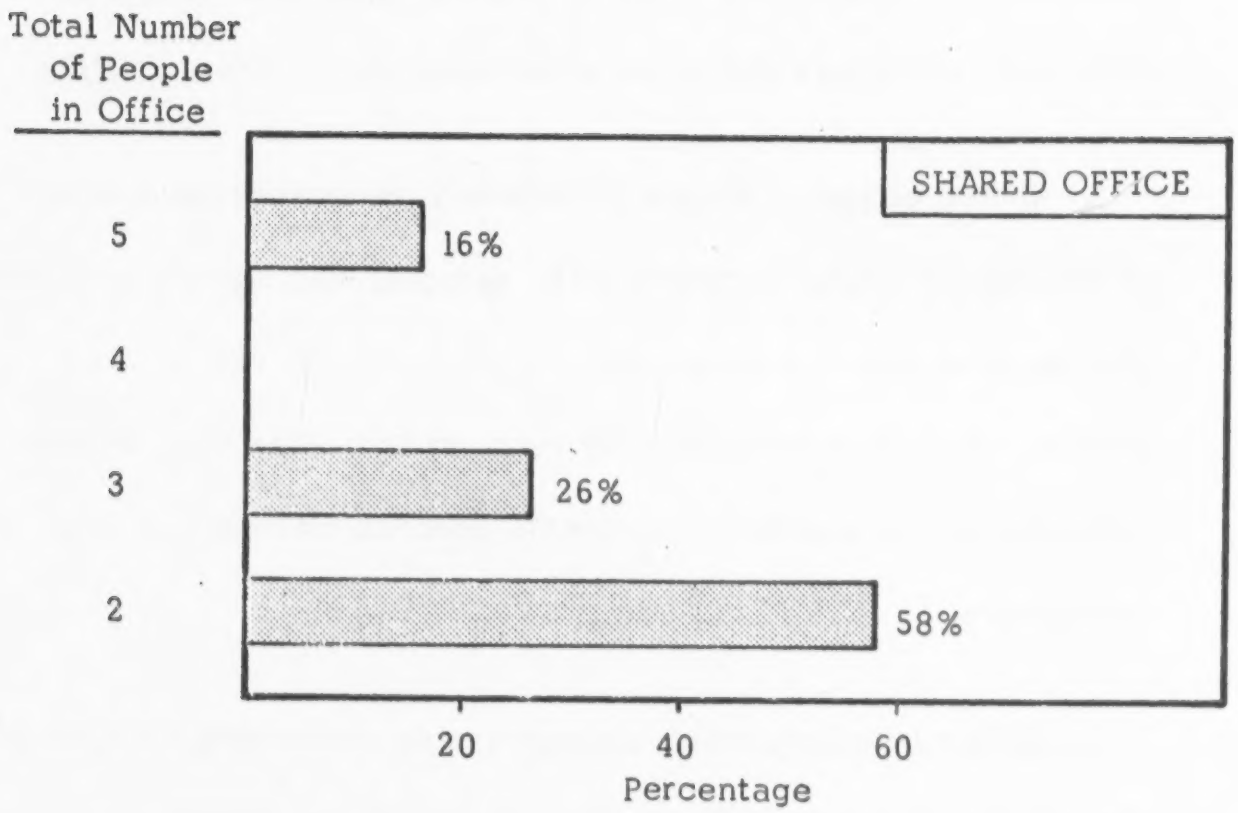


Fig. 53 --Shared offices in drafting facilities

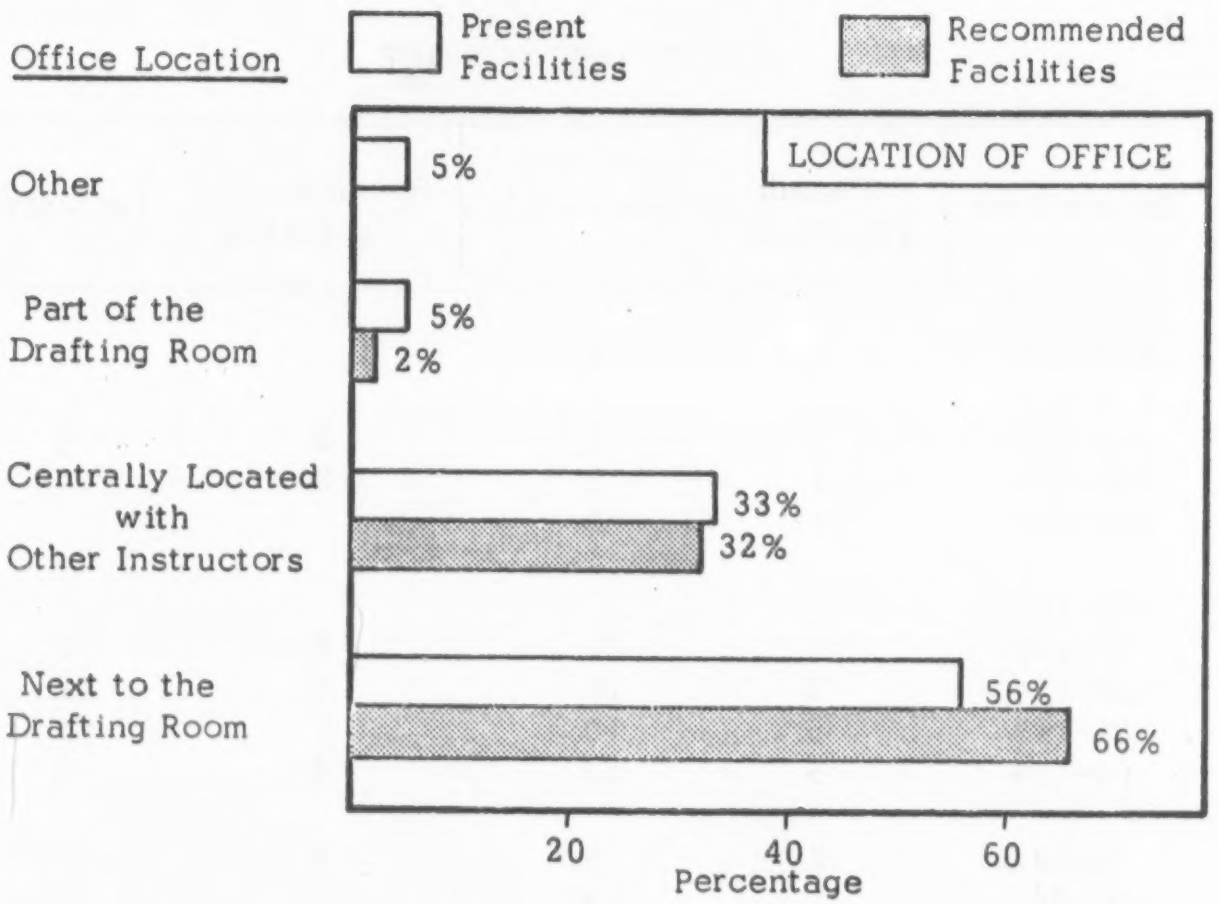


Fig. 59--Location of offices in drafting facilities

TABLE 29

AREA OF OFFICE SPACE

Square Feet	Present Facilities	Percentage	Recommended Facilities	Percentage
225-254	1	2		
210-224				
195-209	4	8	2	6
180-194	1	2	2	6
165-179	1	2		
150-164				
135-149	13	26	8	26
120-134	5	10	9	30
105-119	5	10	1	3
90-104	5	10	4	13
75-89	2	4	4	13
60-74	7	14		
45-59	3	6	1	3
30-44	3	6		
Totals	50	100%	31	100%

Summary:

	Mean	Median	Range
Present Facilities:	116.5 SF	119.5	226-30+1=197
Recommended Facilities:	127.0 SF	128.7	196-48+1=149

feet of office space. The summary at the bottom of Table 29 shows little difference between the average present and average recommended office sizes; however, the ranges for both are large.

Office typewriter.--The percentage of drafting personnel with a typewriter in their office is shown in Figure 60. Twenty-eight instructors (49 percent) had a typewriter in their office and thirty-eight respondents (83 percent) recommended a typewriter.

Office adding machine.-- Figure 61 shows the present and recommended percentage of drafting personnel who had an adding machine in their office. Eight instructors (14 percent) indicated they had an adding machine in their office and twenty-nine people (57 percent) were of the opinion that an adding machine was needed in an office.

Office calculator.--The present and recommended percentage of drafting personnel that had a calculator in their office is shown in Figure 62. Seven drafting personnel (12 percent) reported they had a calculator in their office and twenty-six instructors (52 percent) recommended one.

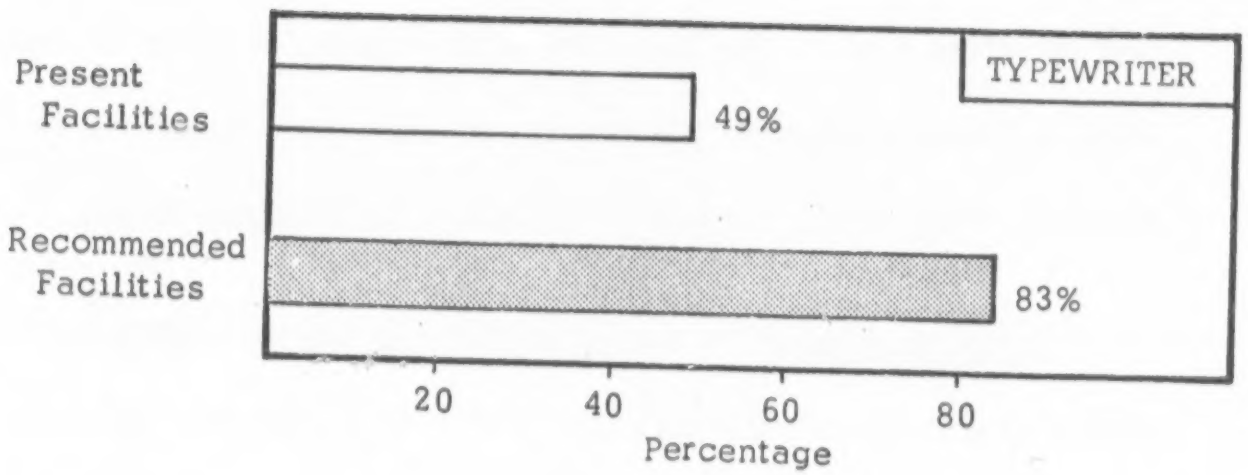


Fig. 60 --Typewriters in offices

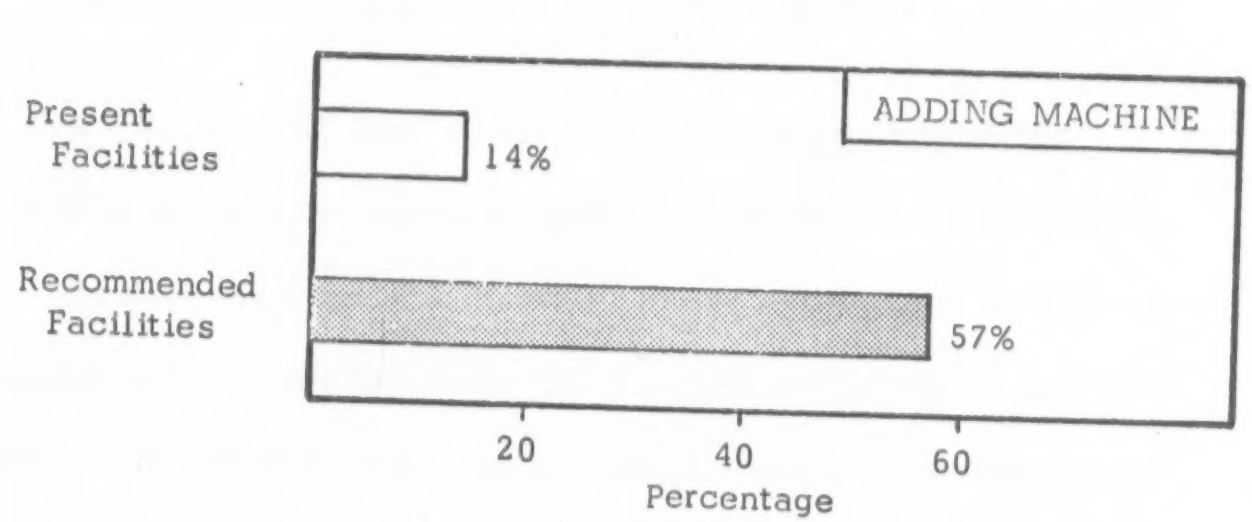


Fig. 61 --Adding machines in offices

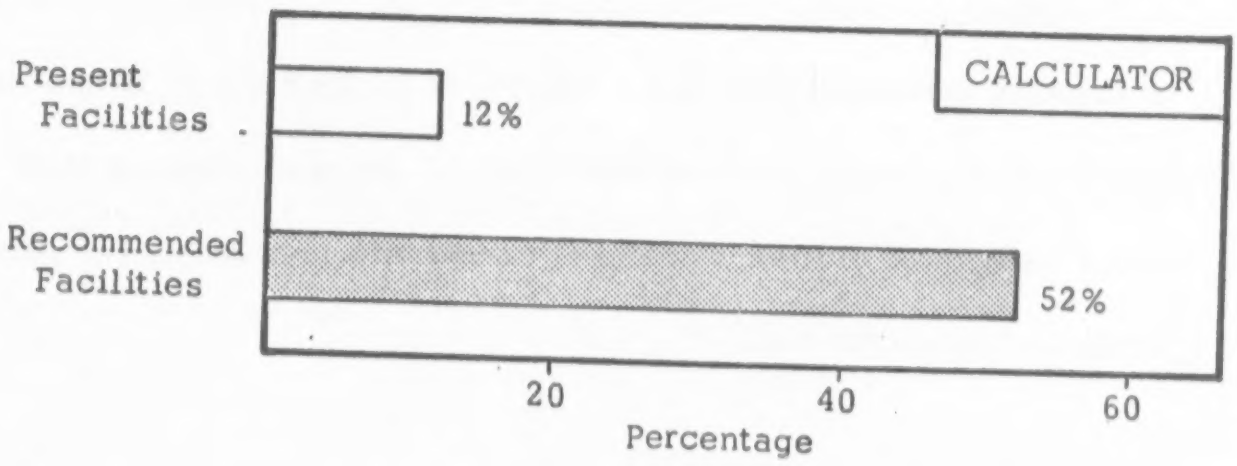


Fig. 62 --Calculators in offices

Office telephone.--Figure 63 illustrates the present and recommended percentage of drafting personnel who had a telephone in their office. Thirty-three instructors (58 percent) indicated they had a telephone in their office and forty-one instructors (85 percent) recommended one.

Office intercom.-- The percentage of drafting personnel who had an intercom, other than a telephone, in their office is presented in Figure 64. Twelve respondents (21 percent) reported they had an intercom system in their office and fourteen instructors (29 percent) recommended one.

Office drafting table.--Figure 65 illustrates the present and recommended percentage of instructors who had a drafting table in their office. Eighteen instructors (32 percent) stated they had a drafting table in their office and thirty-seven respondents (73 percent) recommended one.

Educational enrichment includes drafting libraries, display cases, and bulletin boards. The following information on educational enrichment facilities is illustrated by a table and graphs.

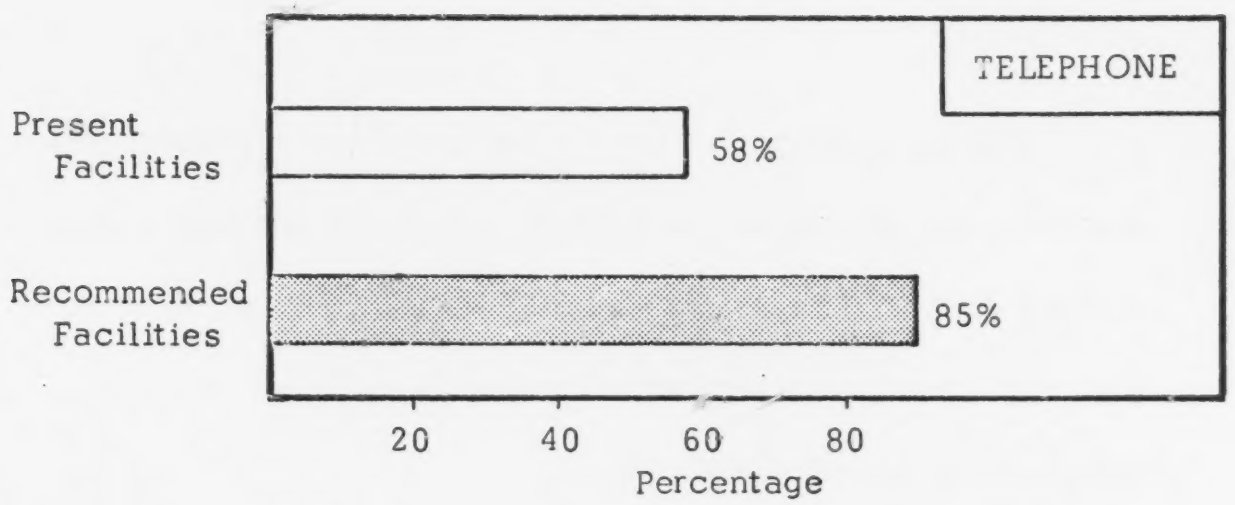


Fig. 63 --Telephones in offices

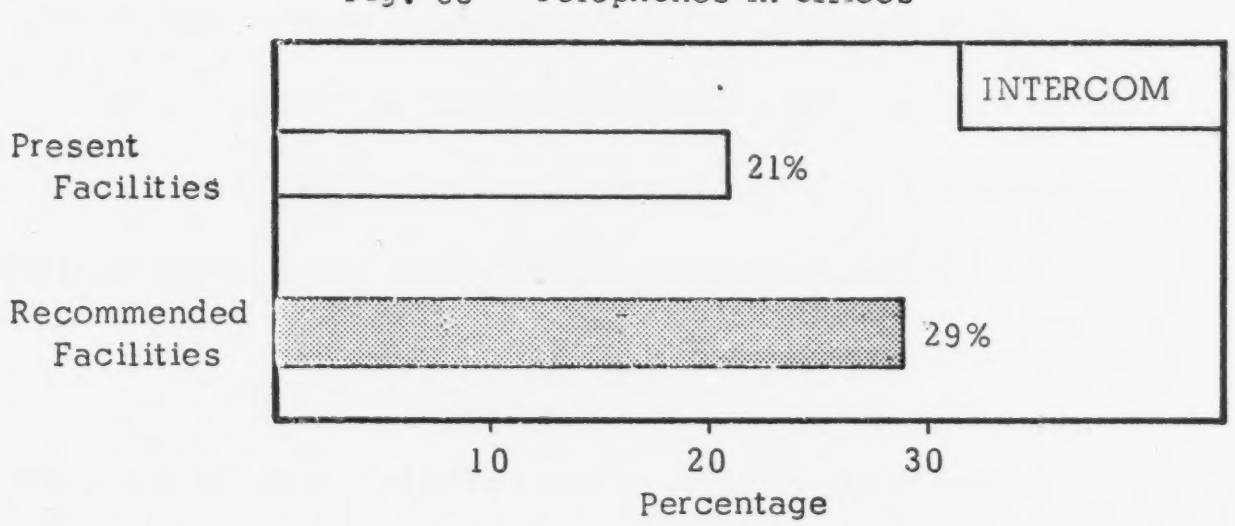


Fig. 64 --Intercoms, other than telephones, in offices

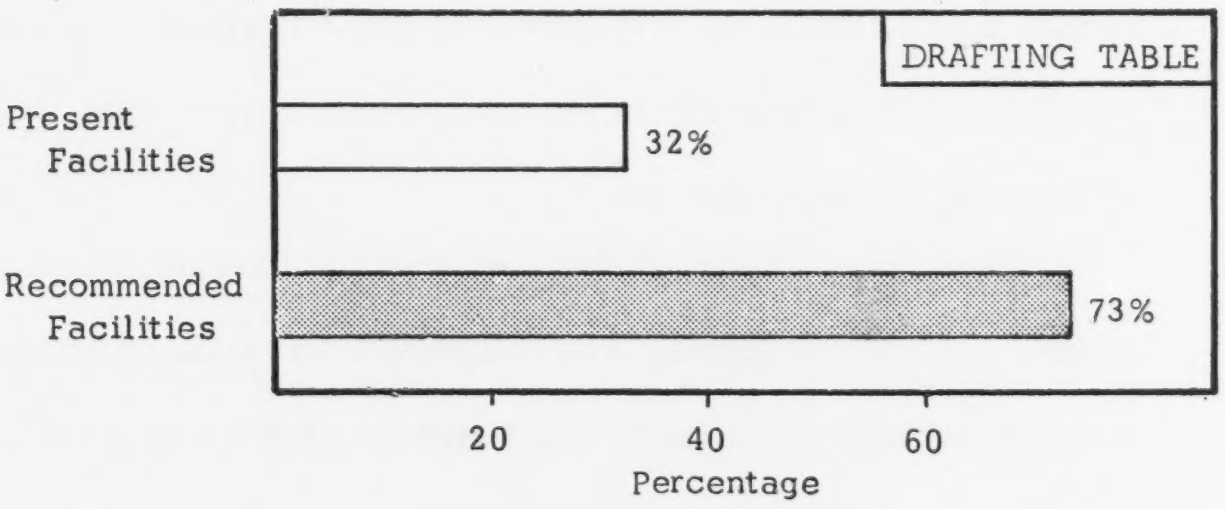


Fig. 65 --Drafting tables in offices

Drafting libraries.--The percentage of drafting directors who had and recommended a drafting library is shown in Figure 66. Seventeen directors (63 percent) stated they had a drafting library and fifty-three drafting personnel (90 percent) recommended one.

Table 30 presents the number of books in the various drafting libraries. Based on the responses of fifteen directors, the average number of books per library was eighty-eight.

The present and recommended location of drafting libraries is shown in Figure 67. Twelve directors (60 percent) indicated their library was located either in a drafting room or departmental office. Twenty-one respondents (72 percent) recommended a library be located in a drafting room or separate room.

Display cases.--The present and recommended sizes of display cases of drafting facilities is shown in Table 31. The summary at the bottom of the table shows the mean, median, and range of cubic feet of display space. The approximate dimensions of the average display case were 6' wide by 1 1/2' deep by 5' high. For recommended facilities, the average dimensions were 7' wide by 1 3/4' deep by 6 1/2' high.

Figure 68 illustrates the present and recommended location of display cases. Nine directors (56 percent) indicated their

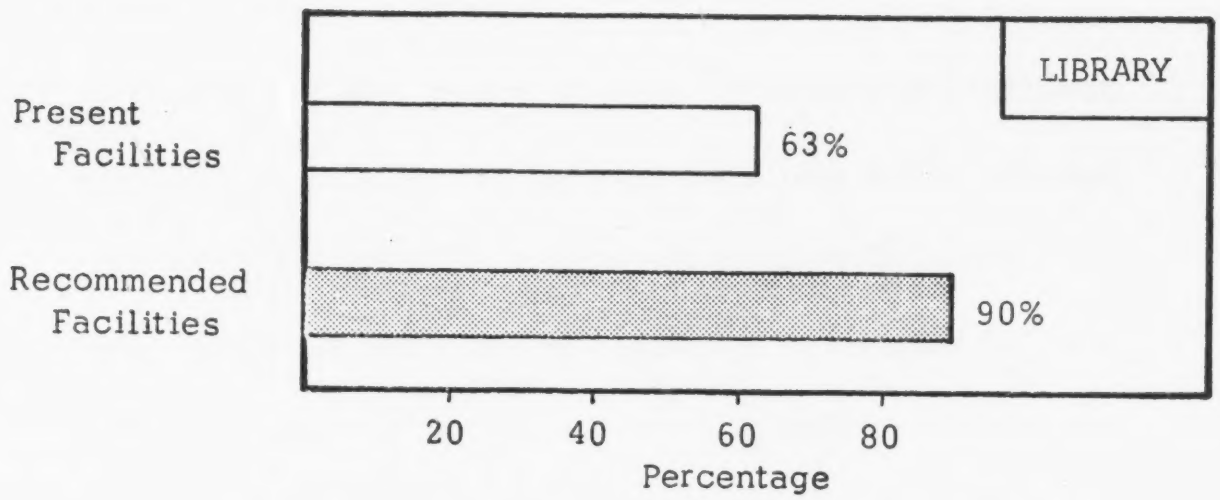


Fig. 66 --Libraries in drafting departments

TABLE 30

NUMBER OF BOOKS IN DEPARTMENTAL DRAFTING LIBRARIES

Number of Books	Number of Drafting Departments	Percentage of Colleges
250	1	7
125	1	7
100	6	39
75	1	7
65	1	7
50	3	19
45	1	7
20	1	7
Totals	15	100%

Summary:

	Mean	Median	Range
Present Facilities:	88	87	250-20+1=231

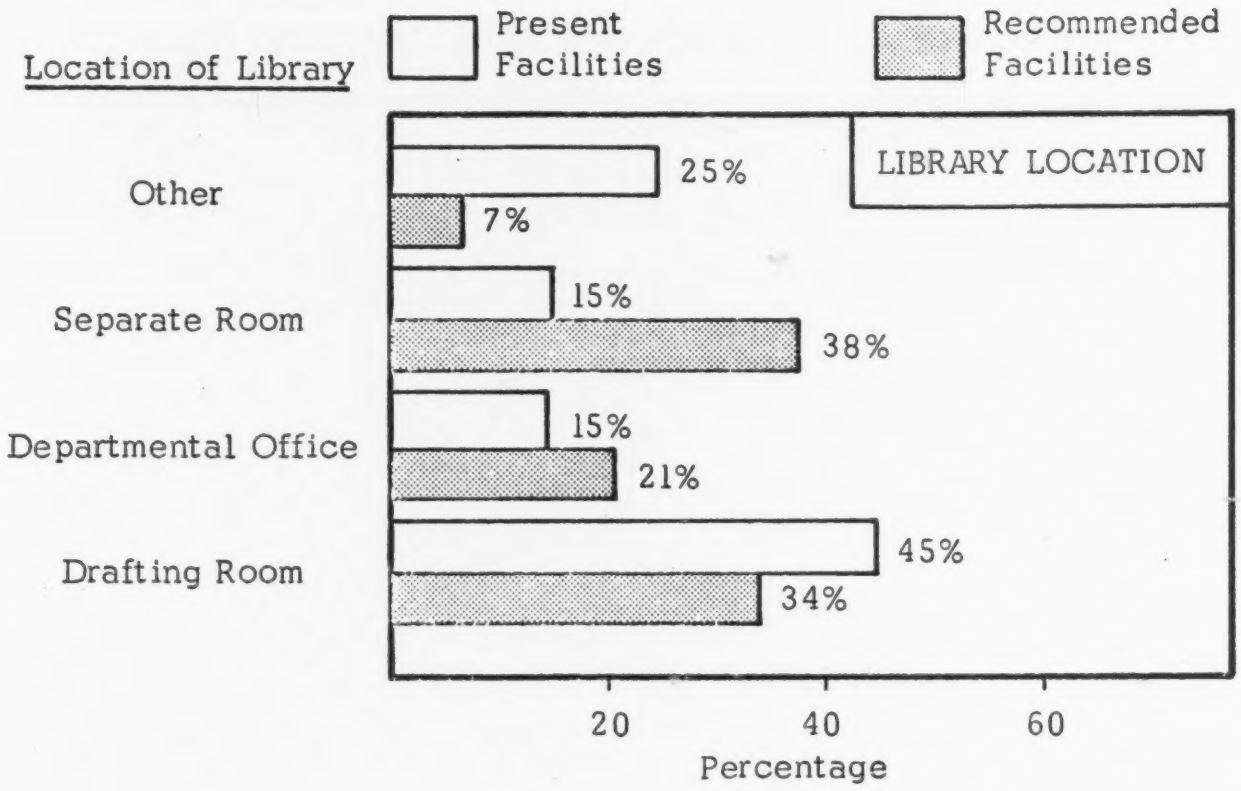


Fig. 67 --Location of drafting libraries

TABLE 31

THE PRESENT AND RECOMMENDED SIZES OF DISPLAY CASES OF DRAFTING FACILITIES

Size of Display Cases (Square Feet)	Present Facilities	Percentage	Recommended Facilities	Percentage
180-194	1	4		
165-179				
150-164	1	4	1	3
135-149			1	3
120-134			2	6
105-119				
90-104	3	12	3	8
75-89				
60-74	5	20	5	14
45-59	2	8	11	30
30-44	3	12	3	8
15-29	5	20	10	28
0-14	5	20		
Totals	25	100%	36	100%

Summary:

	Mean	Median	Range
Present Facilities:	36.9	42.5	192-3+1=190
Recommended Facilities:	57.8	51.3	160-21+1=140

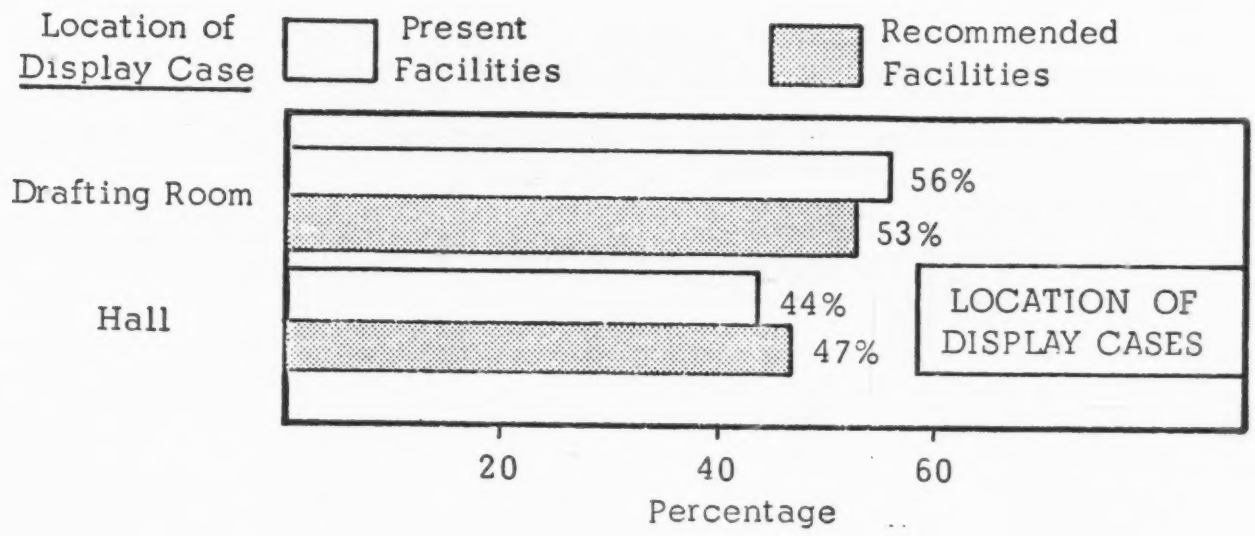


Fig. 68 --Location of display cases

display cases were located in drafting rooms and twenty drafting personnel (53 percent) recommended that display cases be located in drafting rooms.

Bulletin boards.--The different sizes of bulletin boards for present and recommended drafting facilities are shown in Table 32. Fifty-two respondents (75 percent) reported bulletin board sizes ranging from ten to thirty-four square feet and thirty instructors (78 percent) recommended the same size range. The average dimensions for bulletin boards were 5' wide by 4 1/2' high and the average recommended size was 5' wide by 4 3/4' high.

The location of bulletin boards is illustrated in Figure 69. Ninety-four percent of the bulletin boards were located either in the drafting room or in the hall or corridor. Forty-three drafting instructors (72 percent) recommended the drafting room and corridor or hall as the best location for bulletin boards.

An investigation of the drafting facilities was made to determine the provisions for handicapped students and for small group study. Figure 70 shows the kind of facilities for the physically handicapped that were present and recommended for drafting

TABLE 32

THE PRESENT AND RECOMMENDED SIZES OF BULLETIN BOARDS OF DRAFTING FACILITIES

Size of Bulletin Board (Square Feet)	Present Facilities	Percentage	Recommended Facilities	Percentage
60-64	2	3	1	3
55-59				
50-54	3	4	1	3
45-49				
40-44	2	3		
35-39	4	6	3	7
30-34	13	19	7	18
25-29			1	3
20-24	10	14	6	15
15-19	19	27	11	29
10-14	10	14	5	13
5-9	4	6	1	3
0-4	3	4	1	3
Totals	70	100%	38	100%

Summary:

	Mean	Median	Range
Present Facilities:	23	19	64-2+1=63
Recommended Facilities:	23	20	60-5+1=53

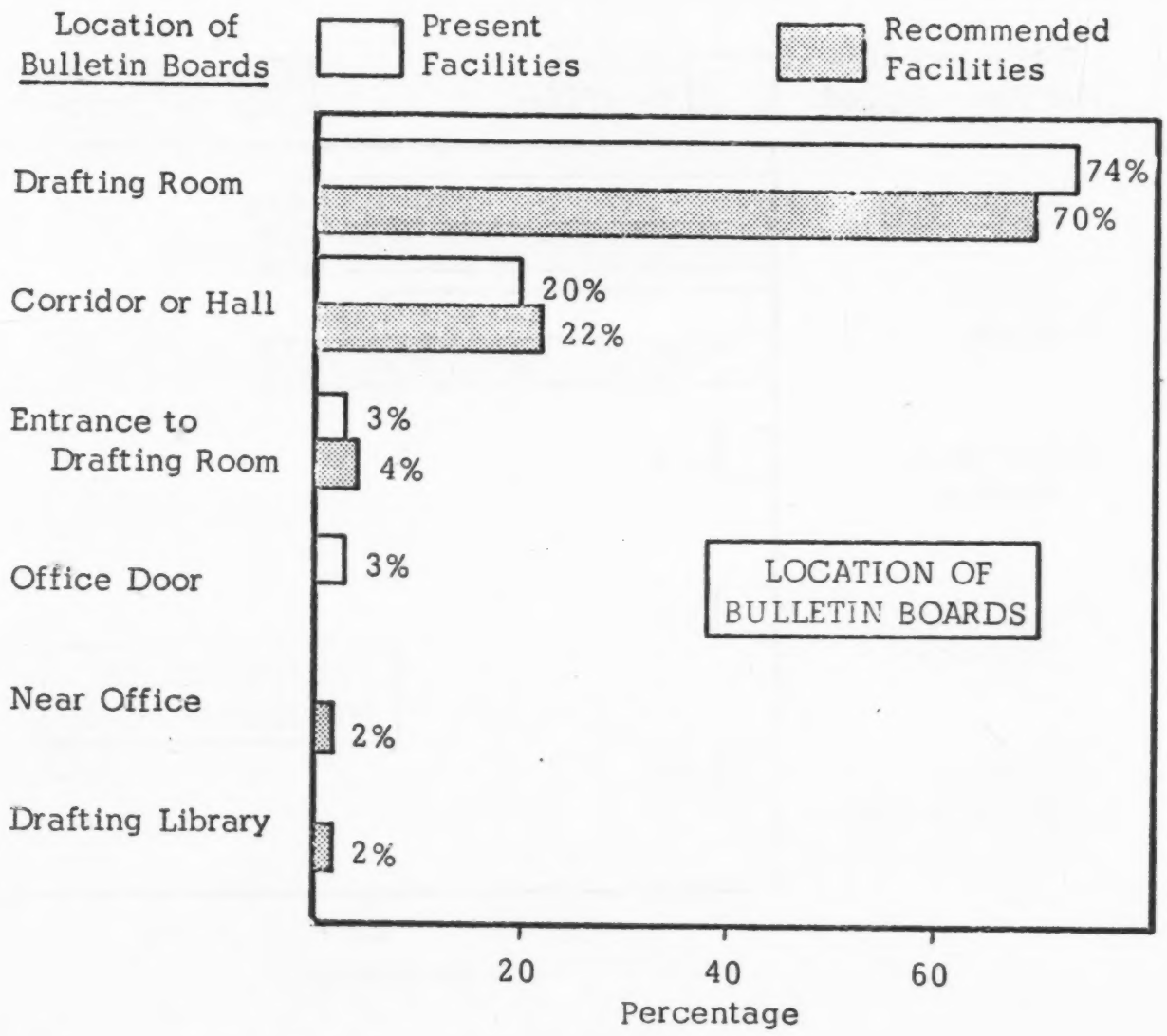


Fig. 69 --Locations of bulletin boards

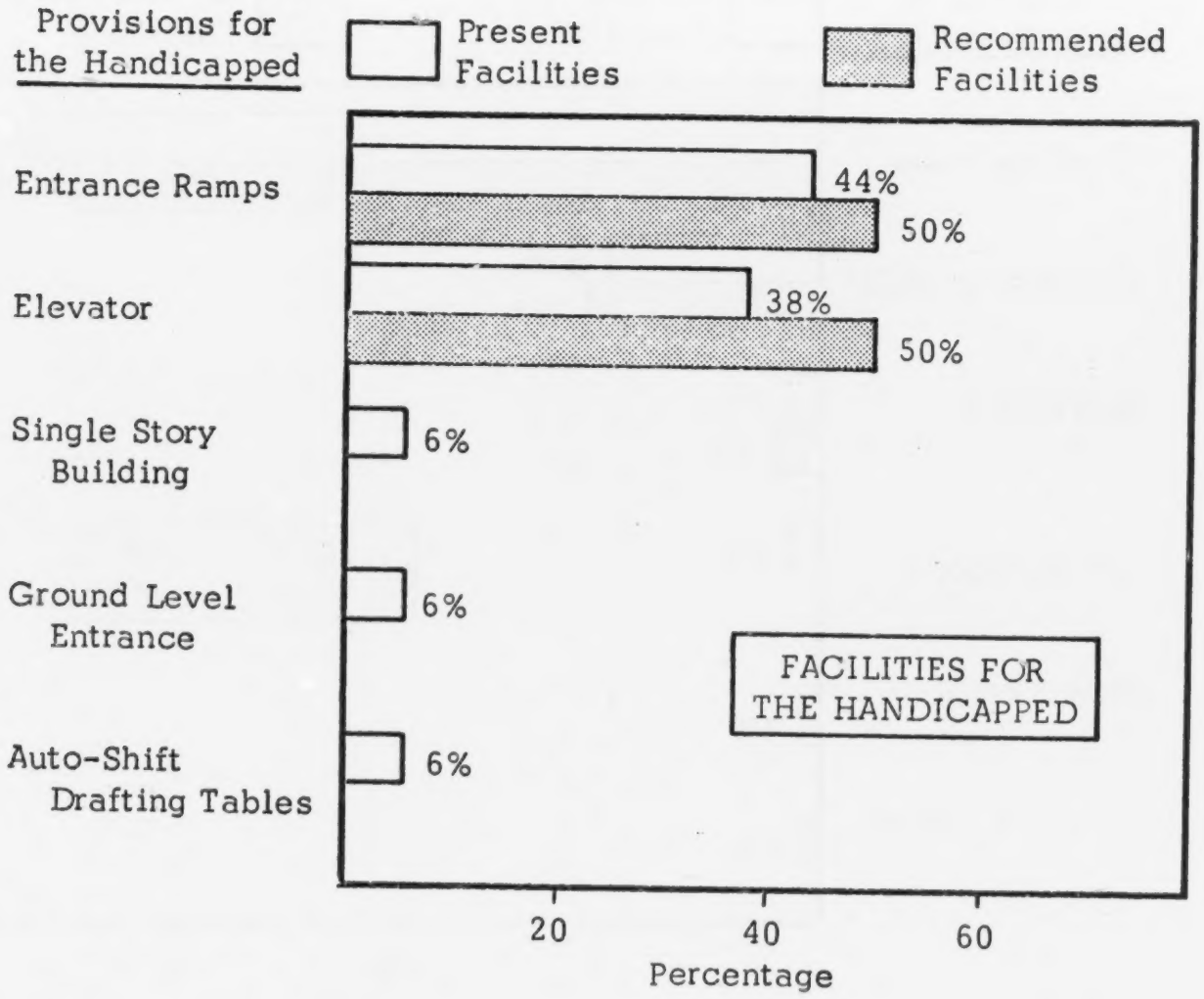


Fig. 70 --Facilities for the physically handicapped

programs. Fourteen directors (82 percent) reported either an entrance ramp or an elevator for the handicapped. Only two drafting personnel offered facility recommendations for the handicapped. One director recommended an entrance ramp and one recommended an elevator.

The present and recommended facilities for small group study is shown in Table 33. Twelve directors (44 percent) stated various locations for small-group study; however, only one college reported having study carrels. Three drafting personnel recommended a conference room for small-group study.

The drafting personnel of the various colleges were asked to indicate the facilities in their department most urgently needing improvements. They were also asked to indicate what they liked or disliked about the physical facilities and to recommend building and equipment changes which should occur within ten years.

Improvements needed.--The most urgently needed items for the improvement of existing drafting facilities as reported by

TABLE 33

SMALL-GROUP STUDY FACILITIES

Location of Study	Present Facilities	Percentage	Recommended Facilities	Percentage
Classroom	1	25		
Instructor's Office	2	16		
Carrel	1	8		
Print Room	1	8		
Separate Room	1	8		
Conference Room	1	8	3	100
Work Room	1	8		
Library, Drafting	1	8		
Library, College	1	8		
Totals	12	100% (Approx.)	3	100%

drafting personnel are presented in Table 34. The numbers following each item indicate the frequency with which the improvements or additions were reported. The frequencies show that drafting tables and equipment were reported more often than were other items. Larger facilities, air brush provisions, and audio-visual equipment were each reported more than twice.

Features that were liked.--Table 35 shows the features that drafting personnel liked about their buildings and equipment. The three items most frequently reported were good drafting equipment, well designed facilities, and ample illumination.

Features that were disliked.--Facilities which were disliked by drafting people are listed in Table 36. The four items reported the most often were inferior drafting equipment, limited storage, small office space, and inadequate illumination.

Improvement within five years.--The drafting personnel of each college were asked to suggest changes which should occur to their facilities within five years. Table 37 shows that new buildings, enlargement of existing buildings, and acquiring more drafting equipment were reported most often.

TABLE 34

THE MOST URGENTLY NEEDED ITEMS FOR THE IMPROVEMENT OF EXISTING DRAFTING FACILITIES

Items	Frequency	Items	Frequency
Air brush facilities	3	Reproduction equipment	1
Audio-visual equipment	3	Small tools and equipment for student use in lab.	1
Better illumination	1	Smaller drafting tables to permit more per laboratory	1
Bulletin board	1		
Coat rack	1	Storage for:	
Darker floor tile	1	Equipment	2
Drafting chairs	1	General	1
Drafting equipment	6	Sensitized paper (refrigeration)	1
Drafting tables	6		
Drafting room thermostat	1	Student projects (models)	1
Display case	1	Supplies	2
Electric erasers	1	Teaching Aids	1
Electrical outlets near drafting tables	1	Vent for reproduction equipment	1
File cabinet	1		
Larger facilities	4	Wash basin	1
Need second drafting room	1	Window coverings	1
Photocopying equipment	1	Work room with tools	1
Private Instructor's office	1	Work table in drafting room	1
Reference library	1		

TABLE 35

ITEMS WHICH DRAFTING PERSONNEL ESPECIALLY LIKED ABOUT THEIR FACILITIES

Items	Frequency	Items	Frequency
Accordian walls	1	Instructor's equipment	1
Adequate storage facilities	2	Instructor's office	1
Ample illumination	7	Large drafting rooms	2
Audio-visual equipment	1	Location and accessibility of visual-aids	1
Carpet in drafting room	1		
Chair-height drafting tables	1	Materials & Processes lab.	1
Chalkboard drafting machine	1	New facilities	1
Closeness of office to drafting room	2	Separate building	1
Controllable room temp.	2	Sufficient drafting equipment	13
Easy access to outside foor from drafting room	1	Suitable acoustics in drafting room	1
Easy access to print room from laboratory	1	Teaching aids	1
Equipment similar to industries	1	Wash basin	1
		Well designed facilities	8

TABLE 36

ITEMS WHICH DRAFTING PERSONNEL ESPECIALLY DISLIKED ABOUT THEIR FACILITIES

Items	Frequency	Items	Frequency
Crowded conditions	1	No provisions for small group study	1
Display case in drafting room	1	No reference facilities	1
Drafting room too small	2	No teacher's closet	1
Drafting tables too small	1	No telephone	1
Improper ventilation in print room	1	No window coverings	2
Inadequate audio-visual equipment	1	No work room	2
Inadequate elevator service	1	Small drafting room	1
Inadequate illumination	4	Too many drafting tables in laboratory	1
Inadequate print machine	1	Undesirable color of floor tile	1
Inadequate temperature control	1	Undesirable facilities	2
Inferior drafting equipment	8	Undesirable location of office	1
Limited office space	4	Undesirable location of print machine	2
Limited storage	6	Undesirable location of rest room	1
Narrow isles in drafting room	1	Undesirable room arrangement	1
No electrical outlets near drafting tables	1	Undesirable room design	1
No facilities for dimming lights	1	Undesirable room properties	1

TABLE 37

FACILITY CHANGES THAT SHOULD OCCUR
WITHIN FIVE YEARS

Facility Changes	Frequency
Acquire better teaching aids	1
Acquire more drafting equipment	5
Acquire more office space	1
Acquire photo drafting and microfilming	2
Add computer drafting	2
Add conference room	1
Construct more storage	1
Construct private offices	1
Enlarge drafting facilities	3
Improved reproduction equipment	1
Larger drafting room	1
New building	5

Improvements within ten years.--Table 38 shows the projected facility changes to occur within ten years. Computerized graphics was suggested by more drafting personnel than were other items. Generally, new facilities and electrical equipment were predicted for the future.

Facility considerations.--Drafting personnel were requested to offer suggestions and recommendations to consider when building or remodeling facilities. Table 39 lists several building and equipment features to review during planning phases of construction.

The drafting directors at each college were requested to indicate the year their drafting building was constructed and the provisions made for upgrading and expanding their facilities. They were asked the number of hours a week their drafting rooms were occupied by a scheduled class, the number of students enrolled for the regular nine months plus summer sessions, and the number of graduates.

TABLE 38

FACILITY CHANGES THAT SHOULD OCCUR
WITHIN TEN YEARS

Facility Changes	Frequency
Add a classroom	1
Add another drafting room	2
Better drafting equipment	2
Closed circuit TV	2
Computerized Graphics	6
Electric drafting machines	1
More automation	1
New building	2

TABLE 39

SUGGESTIONS AND RECOMMENDATIONS TO CONSIDER
WHEN BUILDING OR REMODELING FACILITIES

Facility Considerations	
Adequate office illumination Bulletin boards Built-in projection screen Chalkboards Display cases Electrical outlets accessible to each drafting table Have a lecture room and small study carrel for 3 - 5 students Instructor's office joining drafting room Larger drafting tables	Locate technical building near other disciplines Overhead projector in each drafting room Properly designed drafting room with a separate room for printing, storage and for a drafting library Storage for teaching aids Student storage Suitable acoustical quality Wash basins in each drafting room

Age of drafting buildings.--The year in which the various Texas junior college drafting buildings were constructed is shown in Table 40. Fifteen of the buildings (66 percent) were erected between 1966 and 1968. Nineteen buildings (88 percent) were constructed within the past seven years.

Master building plan.-- Figure 71 illustrates the percentage of drafting directors who had and recommended a written and approved master building plan. Nine directors (38 percent) stated they had a master building plan and fourteen directors (61 percent) recommended one.

Master equipment plan.-- The percentage of directors having a written and approved master plan for equipment and machines is shown in Figure 72. Five directors (22 percent) indicated they had a master plan for equipment and machines and twelve directors (55 percent) recommended one. Eleven directors (85 percent) stated a master plan for equipment and machines should provide for the purchase of future equipment and machines and not merely indicate the items that were purchased at the time the building was constructed.

TABLE 40

AGE OF DRAFTING TECHNOLOGY BUILDINGS

Year	Frequency	Percentage
1968	3	12
1967	6	27
1966	6	27
1965	2	9
1964	2	9
1963	1	4
1958	1	4
1956	1	4
1949	1	4
Totals	23	100%

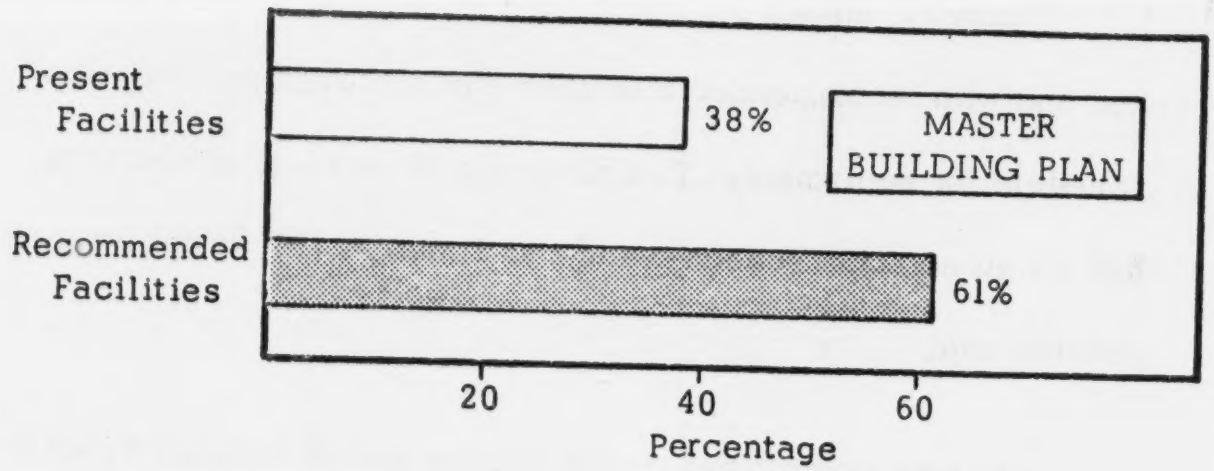


Fig. 71--Written and approved master building plans for drafting departments

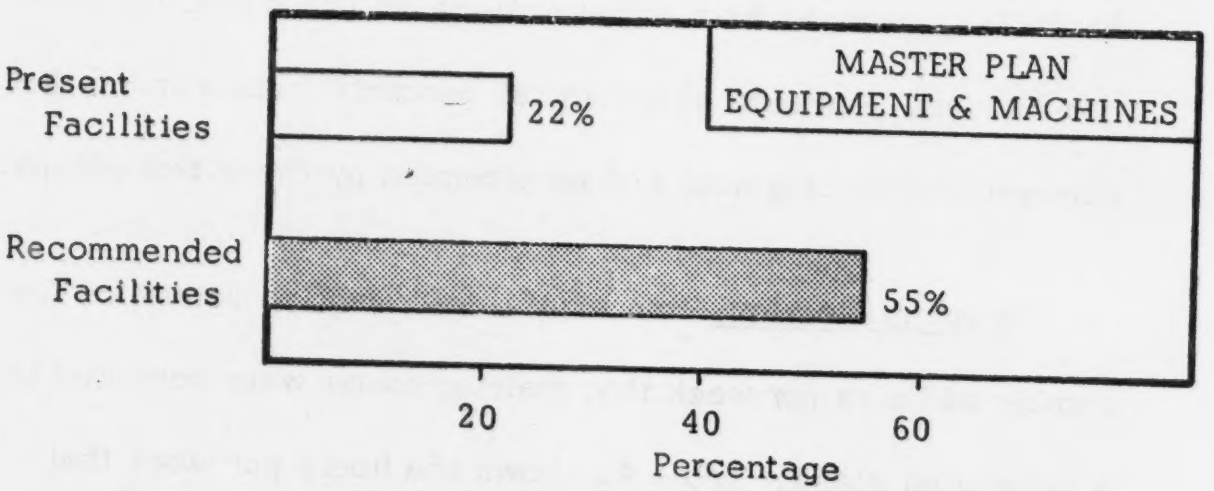


Fig. 72 --Written and approved master plans for equipment and machines for drafting departments

Figure 73 shows the precentage of college directors who had and who recommended a written and approved depreciation schedule for equipment. Two directors (9 percent) stated they had a depreciation schedule and ten directors (59 percent) recommended one.

Advisory committees.--The percentage of drafting directors who received recommendations for facility changes from either college administrators or advisory committees is shown in Figure 74. The directors were asked to indicate if recommendations had come from either group within the past five years. Thirteen directors (54 percent) reported they had received recommendations for facility changes from either college administrators or advisory committees. Fourteen directors (82 percent) recommended that changes should originate and be promoted by these two groups.

Room utilization.--An inquiry was made to determine the number of hours per week that drafting rooms were occupied by a scheduled class. Table 41 shows the hours per week that forty-one drafting rooms were utilized during the fall of 1968. The average drafting room was occupied twenty-five hours per

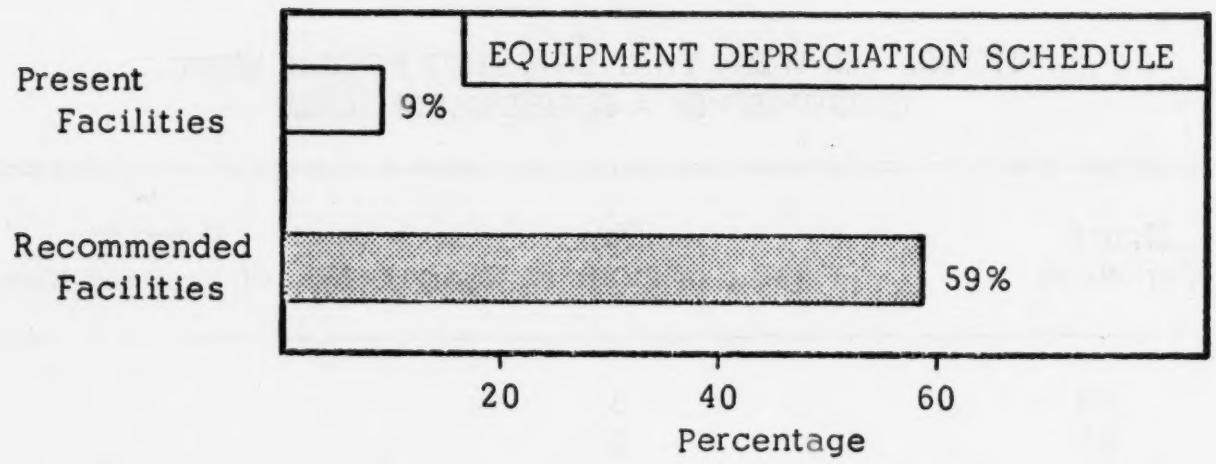


Fig. 73 --Written and approved depreciation schedules for drafting departments

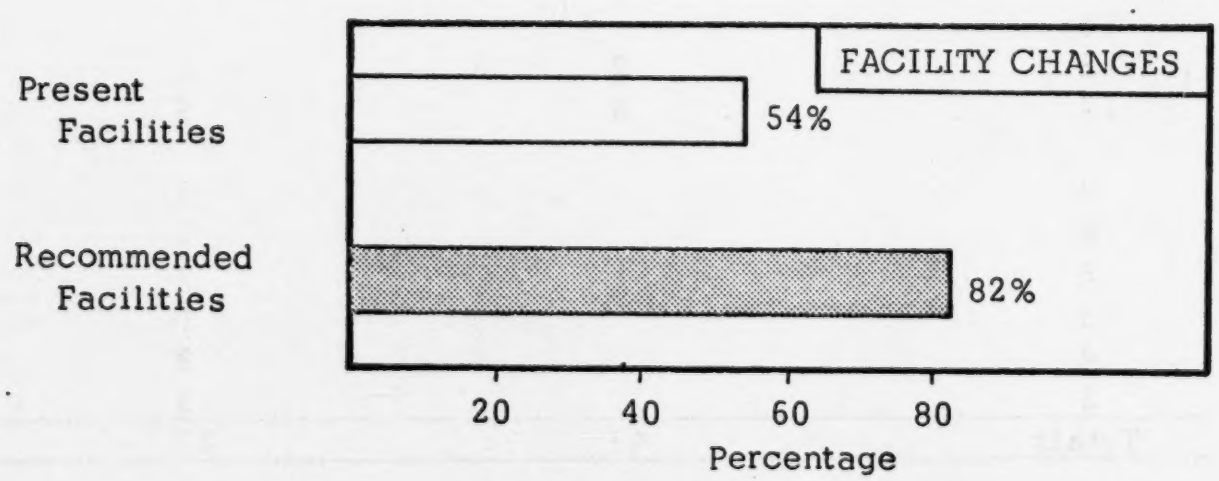


Fig. 74 --Recommendations for facility changes from college administrators and/or advisory committees

TABLE 41

HOURS PER WEEK THAT DRAFTING ROOMS WERE OCCUPIED BY A SCHEDULED CLASS

Hours Per Week	Day (No. of Drafting Rooms)	Evening (No. of Drafting Rooms)
40	3	
35	3	
30	8	
28	2	
27	2	
24	8	
23	1	
22	1	
21	1	
20	1	
19	4	
18	1	
16		3
15	2	1
12	3	5
9		3
8		2
6	1	7
5		1
4		2
3		3
Totals	41	27

Summary:

	Mean	Median	Range
Day	25 hrs/wk	24 hrs/wk	40-6+1=35
Evening	9 hrs/wk	5.5 hrs/wk	16-3+1=14

work-week. For evening instruction, drafting rooms were occupied an average of nine hours per week.

Student enrollment.--The directors were asked to indicate the total number of students enrolled for day, evening, and summer classes for 1967-68 (sixteen colleges had evening classes and eight had summer classes). The number of students divided by the number of drafting rooms at each college provided the number of students per room. Calculations were made for each college to determine the average number of students taught in drafting rooms throughout Texas. Table 42 shows the number of classrooms occupied by a number of students ranging from 1 to 219. For example, the table shows that six drafting rooms among the colleges were each occupied by 90 to 99 students during the day for nine months of 1967-68. If the colleges had two semesters during the nine months, an average of forty-eight students would occupy each room during the semester.

The drafting directors were asked to indicate the approximate percentage of students working toward an associate degree in drafting technology. Data indicated that an average of sixty-four percent

TABLE 42

NUMBER OF STUDENTS TAUGHT IN DRAFTING ROOM FOR DAY, EVENING, AND SUMMER CLASSES DURING 1967-68

Number of Students Per Drafting Room (9 months or summer)	Number of Drafting Rooms		
	Day Classes (9 months)	Evening Classes (9 months)	Both Summer Sessions
210 - 219	1		
150 - 159	1		
140 - 149	2		
130 - 139	2		
120 - 129			
110 - 119			
100 - 109	1		
90 - 99	6		
80 - 89	4		
70 - 79	2	3	
60 - 69	3		
50 - 59		1	
40 - 49	4	2	1
30 - 39	7	8	
20 - 29	6	6	
10 - 19	2	7	3
1 - 9	1	5	13
Totals	42	32	17

Summary:

Average Number of Students Per Drafting Room for 1967-68 (12 months)	Mean	Median	Range
Day	68	67	211-6+1=206
Evening	28	29	75-0+1= 76
Summer	9	7	40-0+1= 41

of the students enrolled in drafting were pursuing a drafting technology degree. The percentage ranged from 15 to 100 percent.

The number of students enrolled for day, evening, and summer drafting classes for 1967-68 was totaled for each college and the square footage of floor space was calculated for each college. In colleges that had more than one drafting room, the area of each room was summed to obtain the total square feet of drafting laboratory space. With the total number of students and total square footage of floor space, a correlation was calculated to see what relationship existed (see Figure 75). The figure shows that the points do not fall on the regression line but there is nevertheless a low positive correlation between floor space and students taught. The coefficient of correlation was $r = .44$.

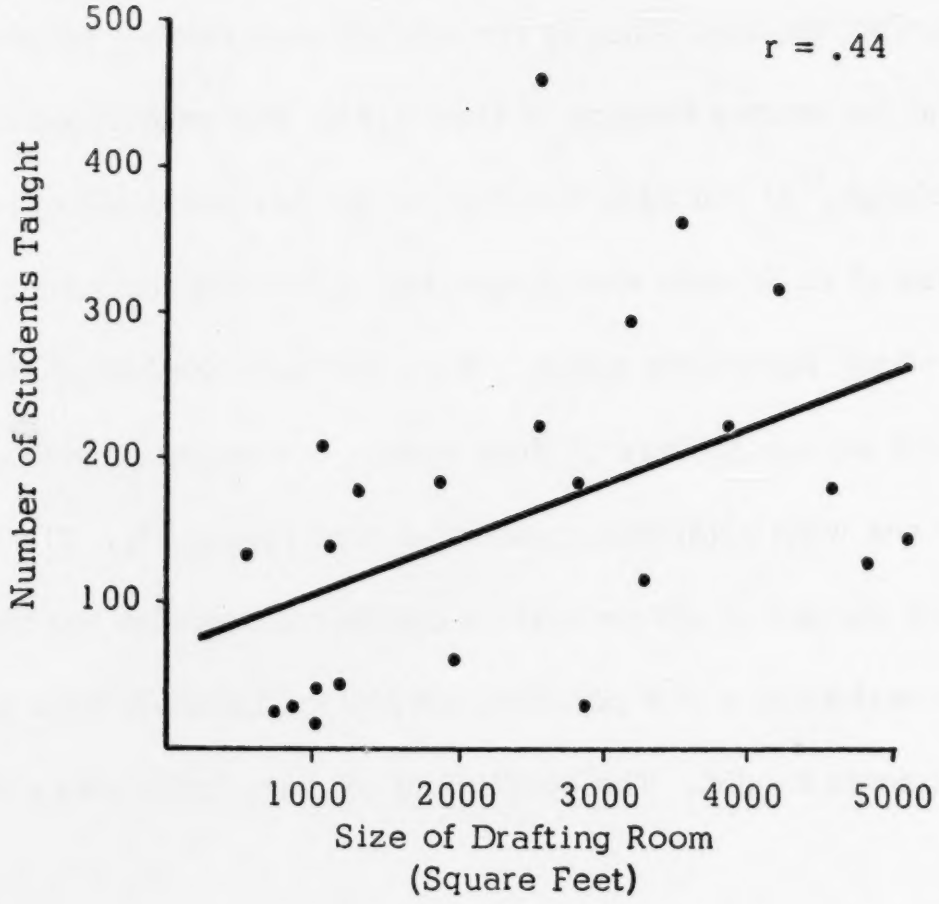


Fig. 75 --Correlation between number of students taught and size of drafting room

C. The Industrial Survey

Research Procedure

Research data were compiled from the survey returns of 375 industrial concerns. These responses represent a sixty-six percent return of 565 questionnaires which were mailed to a stratified sample of national concerns. Eighty-four percent (313 concerns) of these replies were from industrial concerns throughout the state of Texas. The dispersion of plant locations for the Texas concerns is shown according to regional distribution (Figure 76). The distribution of plant locations for the out-of-state concerns as well as the pilot study is shown in Figure 77.

Since the survey instrument was essentially a "battery" of information forms and was designed for a "pooled" rating by area specialist, the number of information forms returned for each specific area of specialization varied proportionally to each representative area. Each industrial concern received a General Information form which was to be completed by the company representative in charge of the drafting personnel. The number of "specialty" information forms a company received depended on the job classifications of the drafting personnel. Not all companies

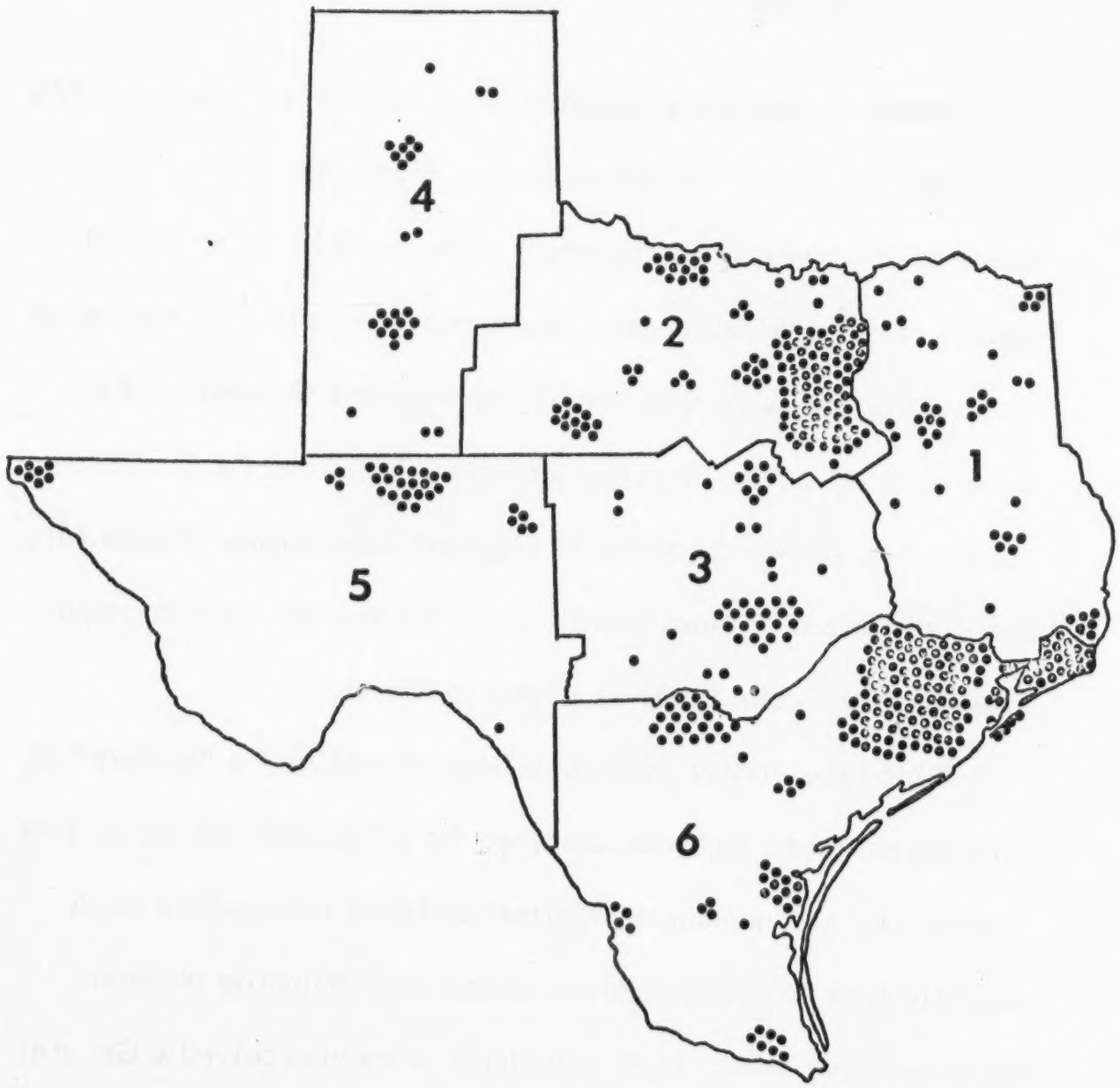
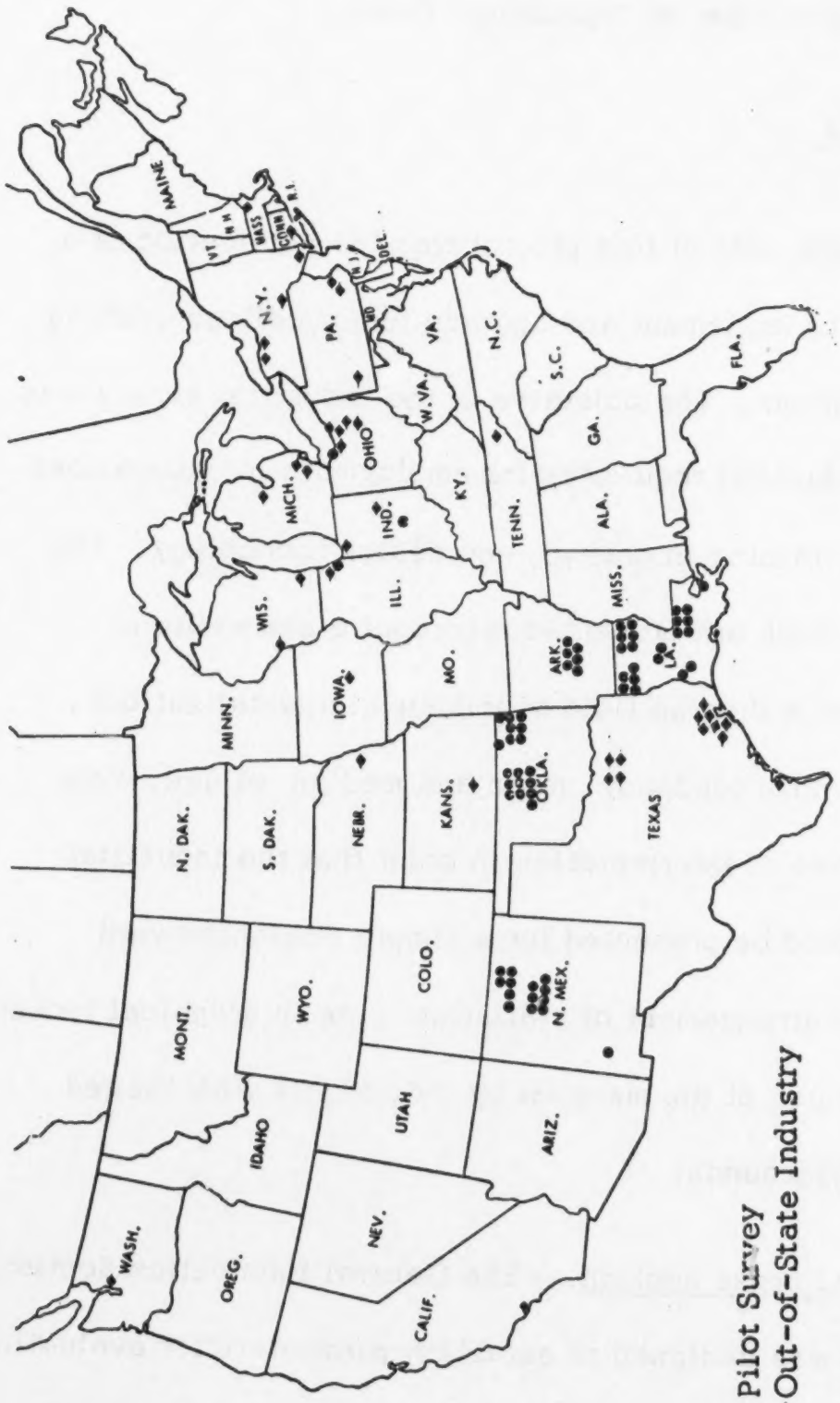


Fig. 76 --Regional Distribution of Texas Industry



Legend: • Pilot Survey
•Out-of-State Industry

Fig. 77--Distribution of Pilot Survey and Out-of-State Industry

returned the General Information form, nor did all companies receive the same number of "specialty" forms.

Analysis of Data

The ultimate goal of this project was the publication of a planning guide to implement and upgrade junior college drafting and design programs. The objective of the industrial survey was to determine industrial requisites for employment in occupations which required training in drafting and design technology. The research data which are presented represent a composite of evaluations from a diverse field of industrial specializations. Measures of central tendency, mean and median values, were selected for ease of interpretation in order that the industrial evaluations could be presented for a simple straightforward analysis. The arrangement of statistical data in graphical format facilitates the use of the material by individuals with limited statistical backgrounds.

Industrial cross section.--The General Information Section of the questionnaire was designed to establish parameters for evaluating the target population. This information will allow drafting instructors to

weigh the value of the research material and evaluate the source of the data. Eighty-eight percent (329 firms) of the participating concerns (375 firms) completed and returned General Information Sections. The research data for this section were derived from these returns.

Size of work force.--The combined personnel of the 329 surveyed concerns represents a total work force of 174,614 employees.

Drafting personnel.--Three percent (5,623) of the total industrial manpower (174,614) of the 329 surveyed companies consisted of drafting personnel.

Women "draftsmen".--Sixty-seven percent (221 firms) of the 329 companies surveyed did not employ women for drafting purposes. Thirty-three percent (108 firms) of 329 companies employed a total of 418 women in a drafting capacity. The total (418) represents .0024 percent of the total manpower (174,614), and only seven percent of the drafting personnel (5,623) of the 329 surveyed companies.

Summary.--The relative size of each concern according to the total number of employees was tabulated and grouped into class intervals as defined by the Directory of Texas Manufacturers.

The modal classification of the frequency distribution was sixteen total employees per company (64 firms). The relative sizes of the industrial concerns are compared in Figure 78 which illustrates the percentage breakdown of class intervals in the frequency distribution.

A comparison of the relative sizes of the drafting departments representing these concerns is shown in Figure 79. Seventy-five percent (246 firms) of the 329 surveyed companies utilized drafting departments with a range from one to sixteen draftsmen. The modal classification (3 draftsmen) was representative of thirty-five percent (116 firms) of the 329 surveyed companies.

Sixty-seven percent (221 firms) of the 329 surveyed concerns did not indicate the employment of women in a drafting capacity. The percentage of women employed for drafting purposes is shown in Figure 80. The modal classification (1.5 women) employed per company involved twenty-three percent (76 firms) of the 329 surveyed companies.

"Want ad" advertising.--Forty-nine percent (161 firms) of the 329 surveyed concerns indicated newpaper advertising was necessary for the recruitment of additional drafting personnel (Figure 81). Fifty percent (164 firms) of the concerns did not use "want ad" advertising in the recruitment of new drafting personnel.

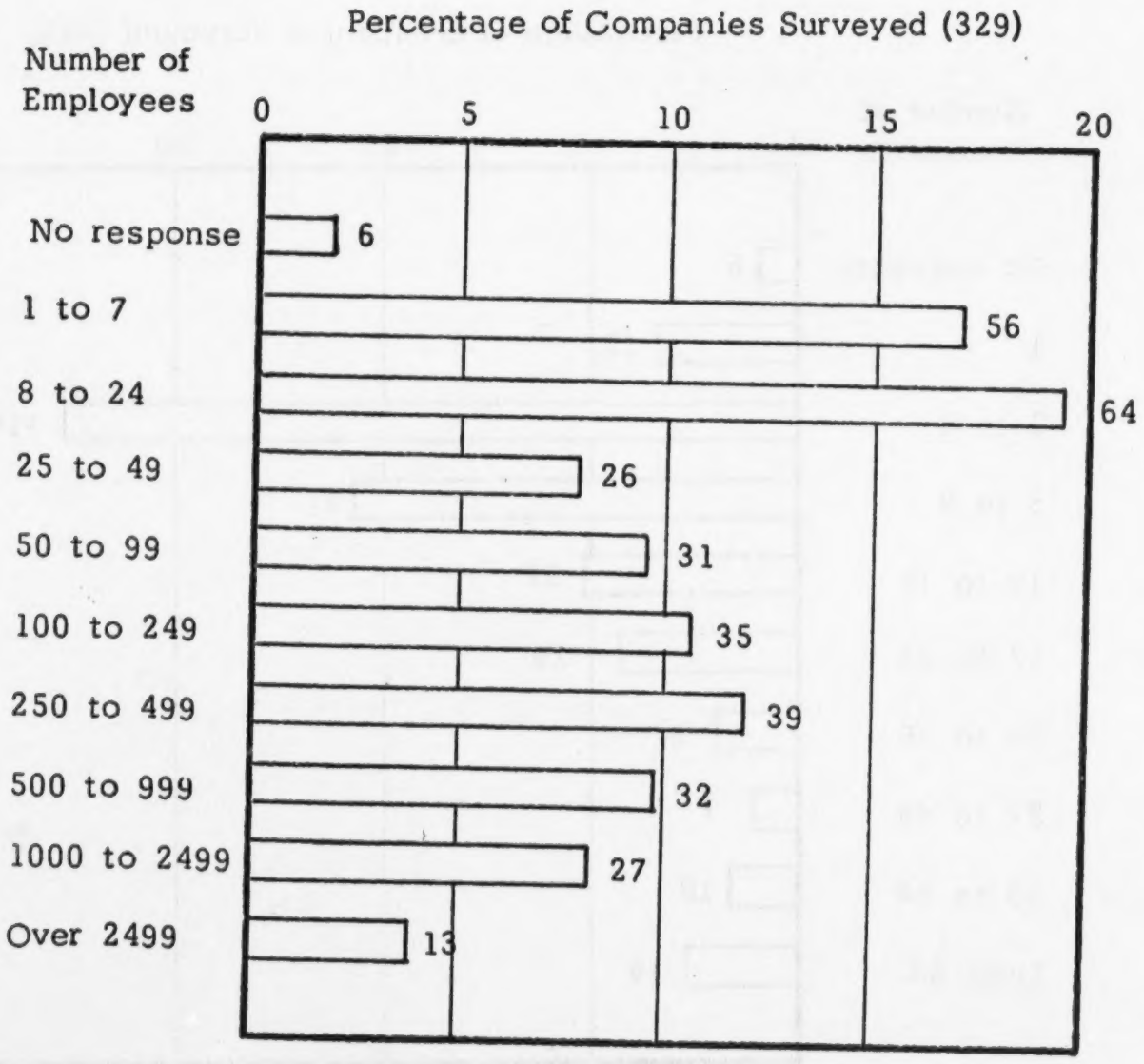


Fig. 78 --Company Size by Number of Employees

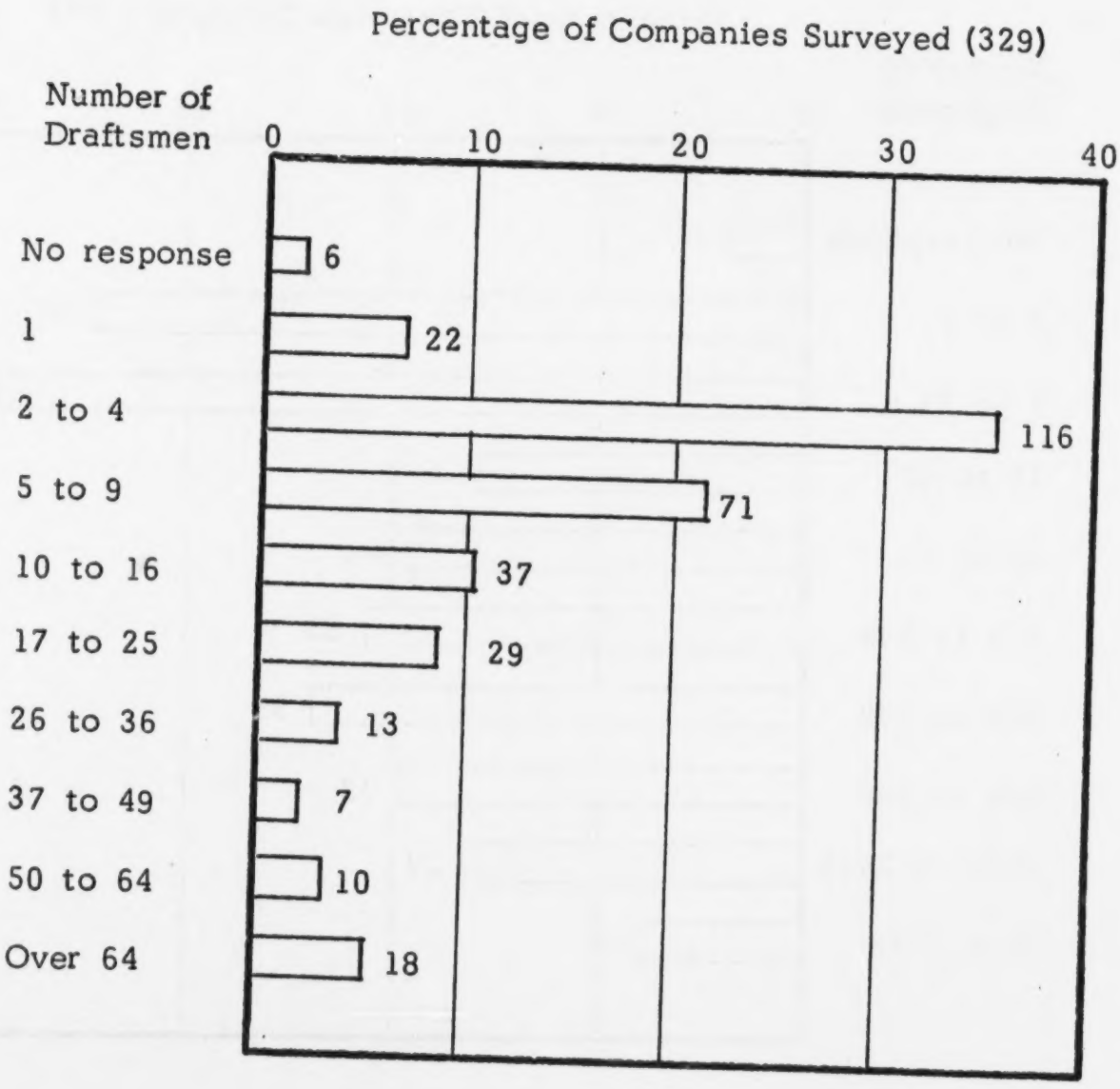


Fig. 79--Sizes of Drafting Departments

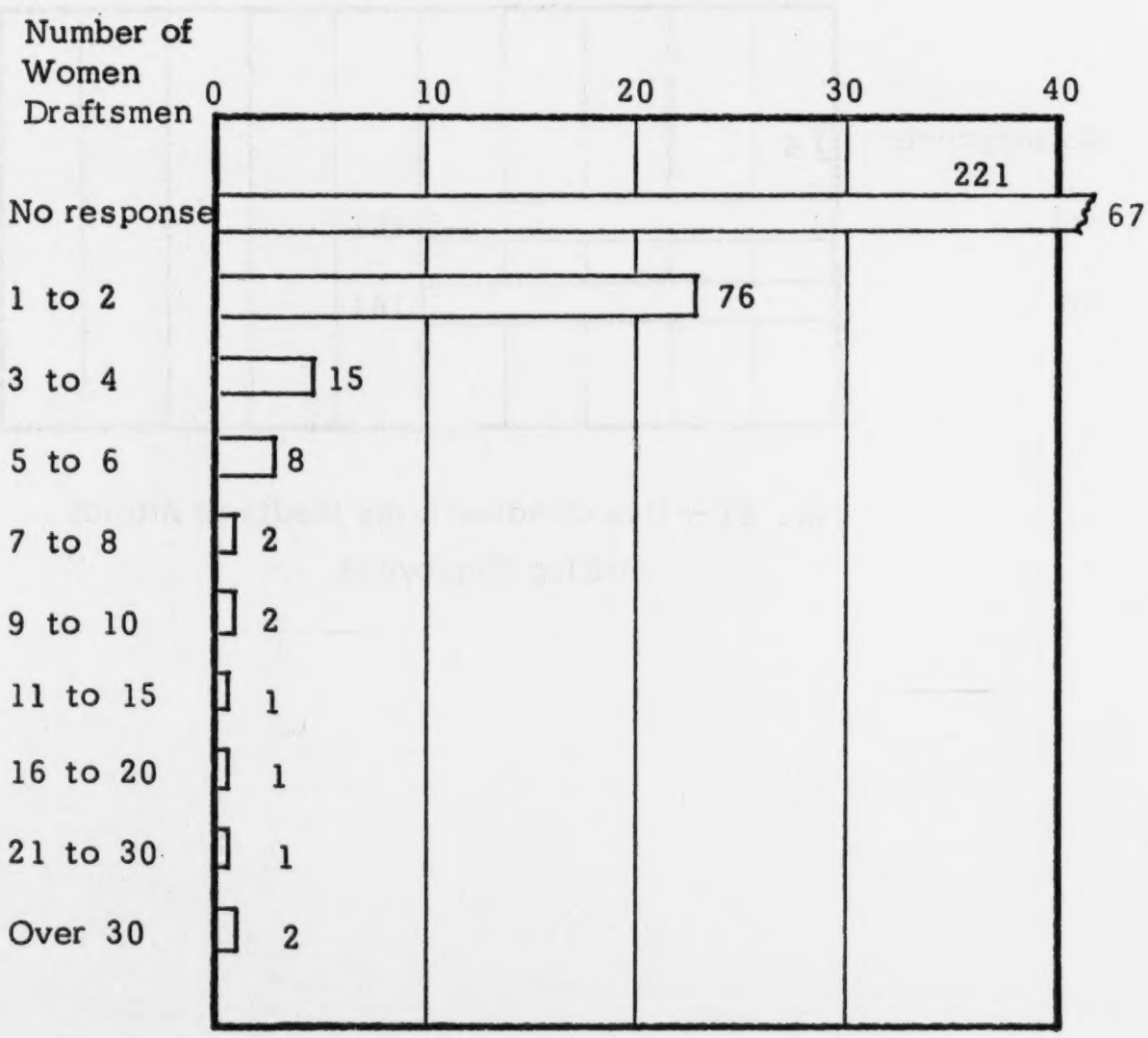


Fig. 80 --Number of Women Draftsmen

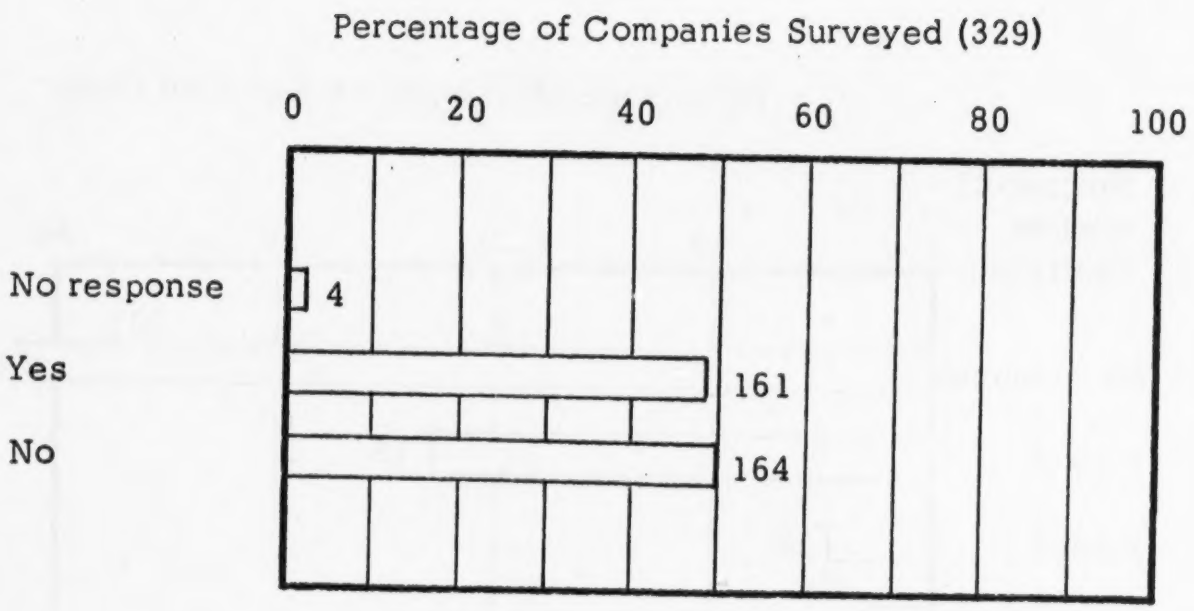


Fig. 81--Use of Advertising Media to Attract Drafting Employees

The concerns (161 firms) using "want ads" in the recruitment of additional drafting personnel indicated the following trends (Figure 82).

1. Sixty-five percent (75 firms) of the concerns advertised in the local region.
2. Twenty-two percent (26 firms) advertised on a statewide scale.
3. Thirteen percent (15 firms) resorted to out-of-state advertising.

Testing programs.--Figure 83 indicates the percentage of firms which employed some type of testing program to establish qualifications for employment in drafting positions. A slight majority (179 firms) representing fifty-four percent of the 329 surveyed companies did not test applicants for drafting positions. One respondent noted his company would like to utilize a testing program, but did not wish to be accused of job discrimination. The types of tests used to screen applicants for drafting positions are shown in Figure 84. Forty-five percent (147 firms) of the 329 surveyed companies tested applicants for drafting positions.

Educational training.--Ninty-eight percent (324 firms) of the 329 surveyed companies required previous training of the applicants for drafting positions. A ranking of these minimal requirements is shown in Figure 85. Forty-seven percent (152 firms) of the 329

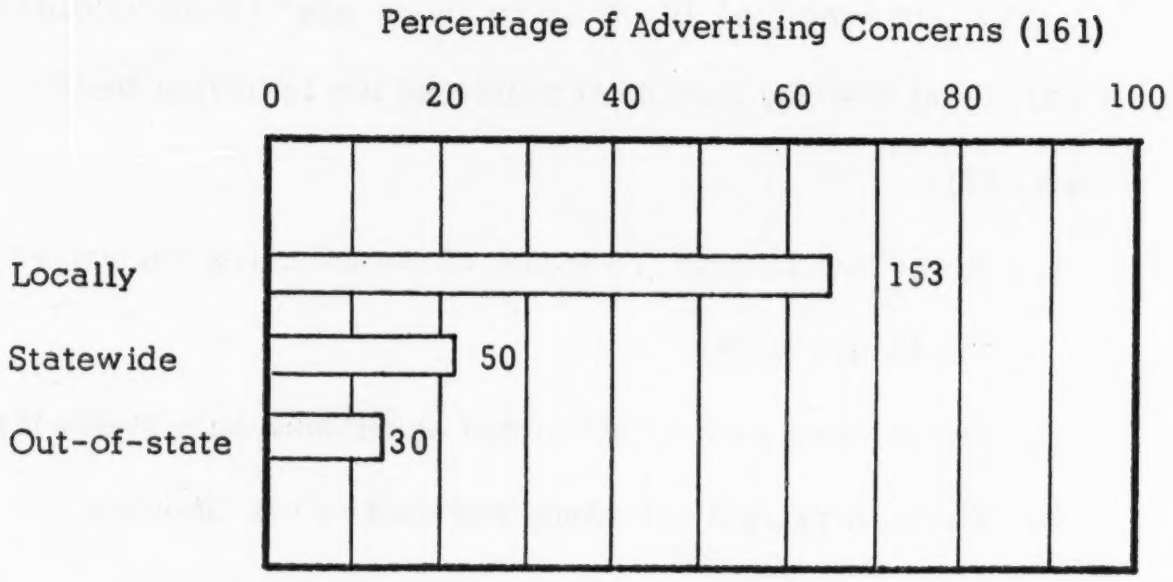


Fig. 82--Advertising Coverage of Concerns Using Want Ads to Recruit Drafting Personnel

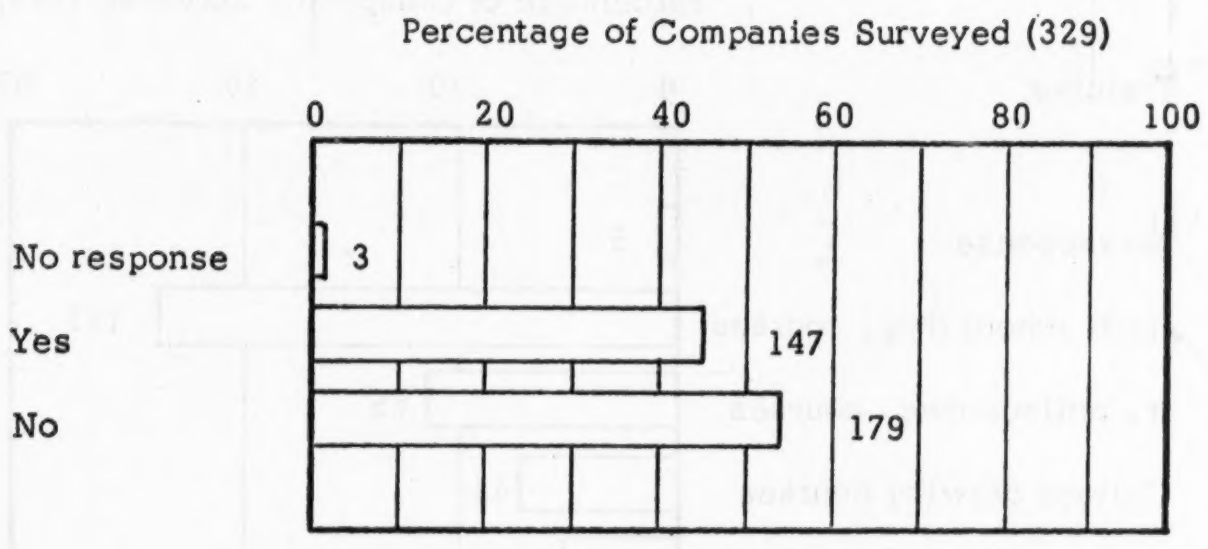


Fig. 83 --Industrial Testing Used to Establish Qualifications for Employment in Drafting Positions

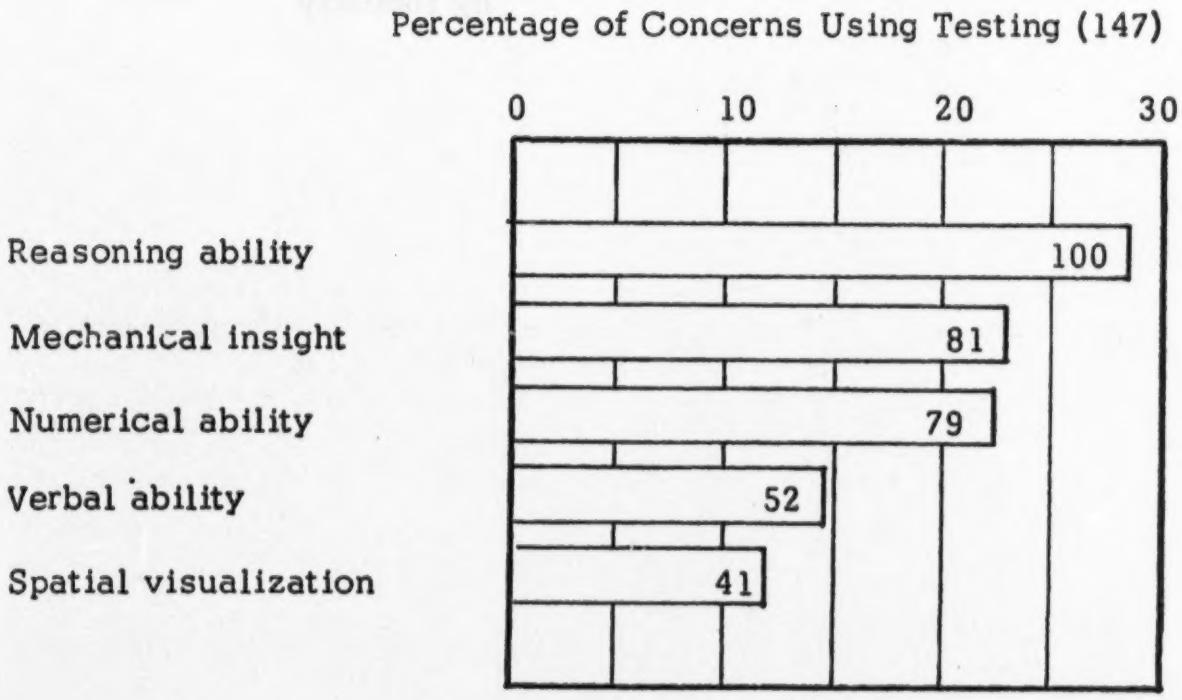


Fig. 84--Types of Tests Used to Screen Applicants

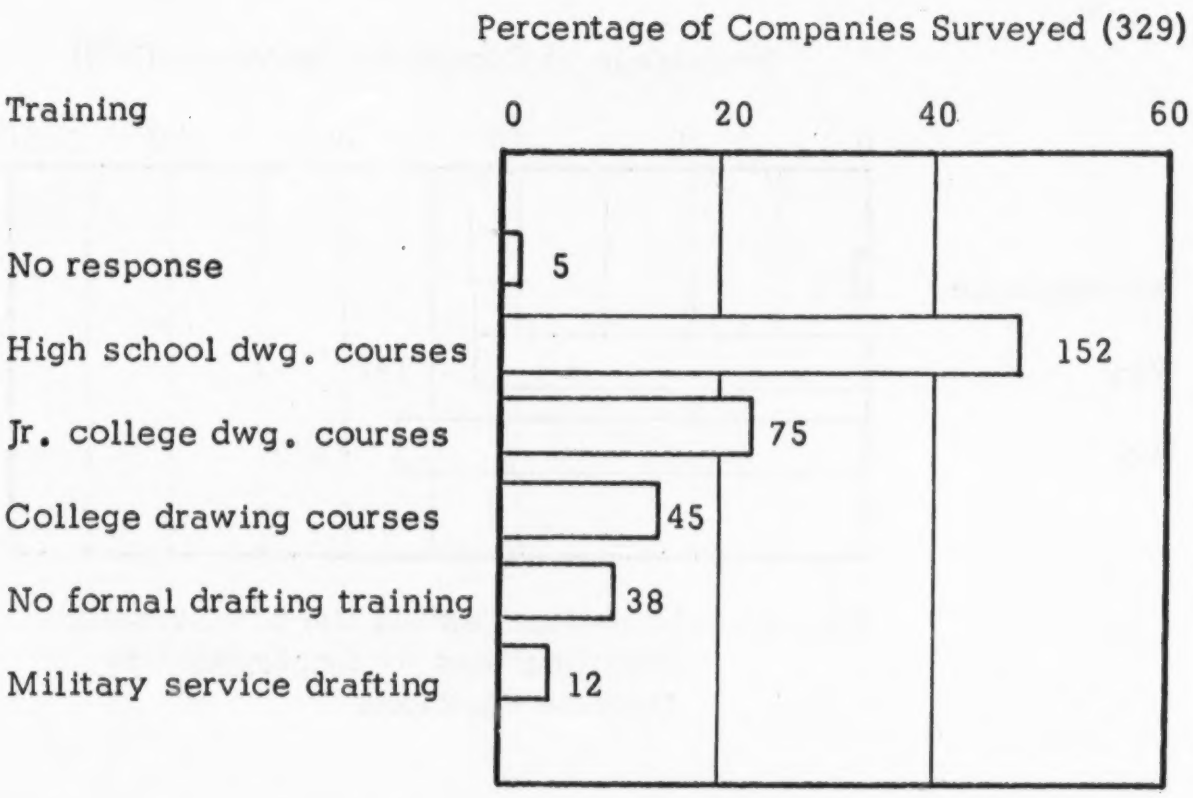


Fig. 85 --Minimal Background Requirements as Desired by Industry

surveyed companies required a minimum of high school drafting courses, while twenty-three percent (75 concerns) desired junior college drawing courses as a minimal requirement.

OJT programs.--Seventy-one percent (232 firms) of the 329 surveyed concerns did not sponsor any type of required formal training or on-the-job educational classes for drafting personnel. Twenty-six percent (86 firms) of the 329 surveyed companies sponsored on-the-job educational training for drafting personnel. The course content of company sponsored on-the-job training classes as well as the number of industrial concerns sponsoring on-the-job educational classes is described in Figure 86. The description of course content in company sponsored on-the-job training classes is based on 116 responses by twenty-six percent (86 firms) of the 329 surveyed companies.

Areas of instruction.-- An open-ended question was included in the General Information Section to explore the course content of on-the-job training programs. Each respondent was requested to list specific instructional topics which were covered in industrial on-the-job training classes. Instructional items were submitted by twenty-six percent (86 firms) of the 329 surveyed companies. These topics are listed in alphabetical sequence as follows:

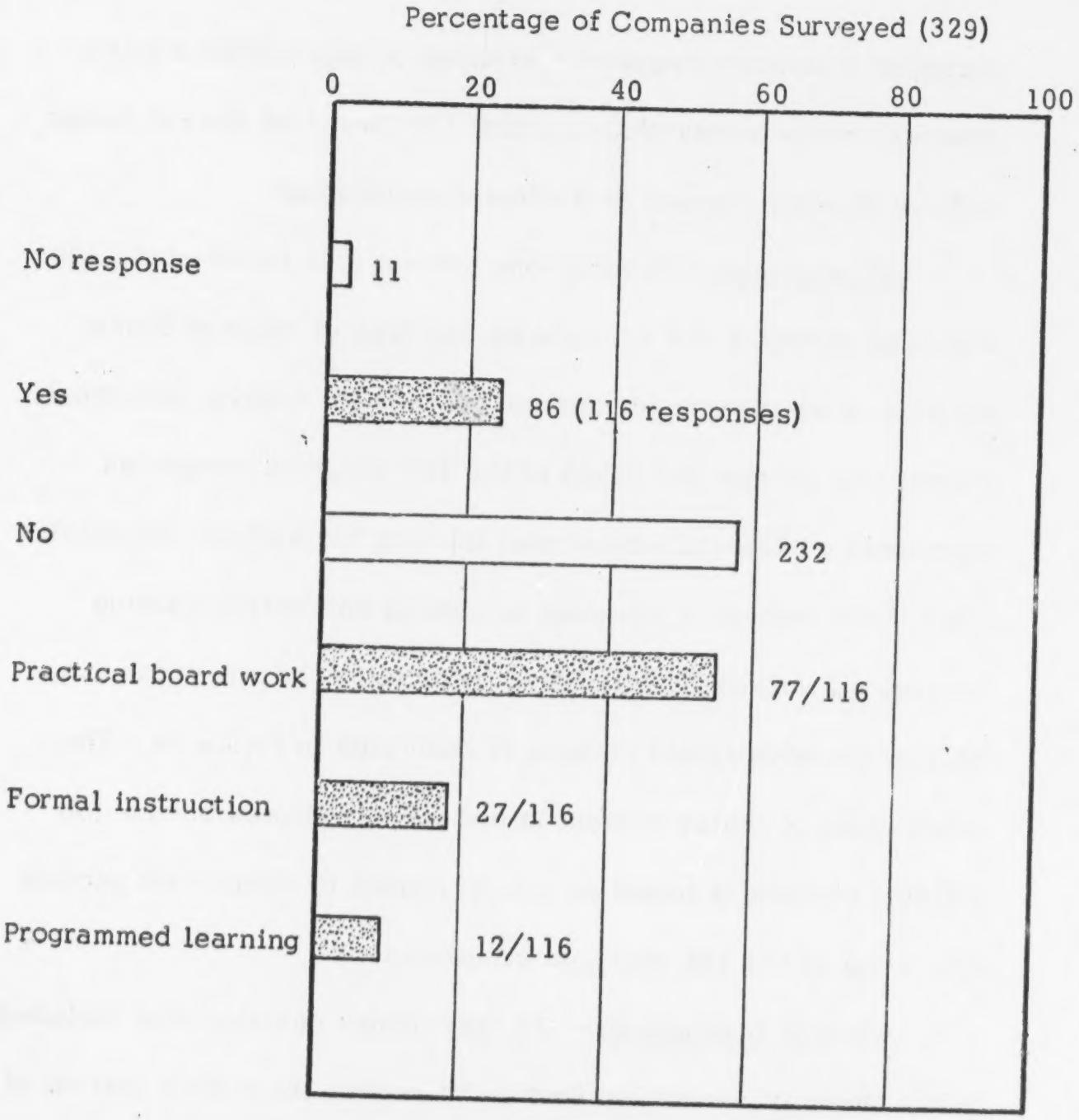


Fig. 86 --Number of Industrial Concerns Sponsoring On-the-Job Training Programs

Alignment
All Phases of:
- Commercial Drafting
- Military Drafting
- Municipal Drafting

Basic Drafting in Discipline:
- Architectural Details
- Structural
- Mechanical

Basic Drafting Skills:
- Drafting Techniques
- Inking
- Lettering
- Line Quality
- Sheet Organization
- Sketching
- Use of Instruments

Blueprint Interpretation
Cartographic Drafting and Photographic Interpretation
Continuous Training Program by Job Rotation
Cross Checking
Detailing
Die Design
Dimensioning:
- Geometric Dimensioning
- Tolerancing
- True Positioning

Electro-Mechanical Drafting, All Phases of Electro-Mechanical
- Assemblies
- Printed Circuit Board Taping Instruction

Encouragement of Minority Groups
Engineering Procedures
Estimating Procedures
Filing
Functional Drafting
General Construction
- Building Techniques
- Job Products

General Drafting Procedures and Practices
Instrumentation and Processes
Interpretation of Design Information
Logics

Mapping and Mapping Processes
Material Specifications
Millwork and Shop Drawings
Numerical Controlled Fabrication Techniques
On-the-Board Training
Pictorial Drawings:
  Isometric
  Perspective
Plan and Profile Drawings
Plotting X-Sections, Profiles, Topography, etc.
Preparation of Highway Plans
Projection
Revision of Prints
Schematics
Sheet Metal Processes
Shop Processes
Specific Engineering Topics:
  Machine Design
  Simple Structures
  Soil Testing
  Hydraulics
Specify Trace and Paste Techniques for Documentation
Standards, Industrial Handbooks, ASME Codes, etc.
Standards, Company:
  Familiarity with Codes and Regulations
  Land-Lease Ownership, Oil Well Information Data
  Use of Microfilm
Substation Design
Supervision of Board Work
Surveying:
  Elementary Procedures and Laws
  How to Plot Engineering and Field Notes
Technical Drawing Layout
Topography
Trigonometry
Working Drawings
Topics as Required by Job Needs

OJT textbooks.--Each respondent was requested to list the instructional literature which was used to implement the company sponsored on-the-job training classes. The following list was compiled from twenty-six percent (86 firms) of the 329 surveyed companies:

Basic Textbooks:
- Engineering Graphics (Seven Publications)
- Architectural Construction

Standards:
- Architectural Graphic Standards
- AISC Detail Manual
- AISC Steel Construction Manual
- ANSI Standards
- AWS Standards
- City Standards
- Company Handbooks and Trade Journals
- CRSI Manual
- Electronic Detailing and Design
- FHA Minimum Property Standards
- Forging Handbooks
- Geometric Dimensioning and Tolerancing
- Structural Detailing
- Mechanical Engineers' Handbook
- Military Standards
- Surveying Standards
- Route Surveying
- Texas Highway Department Manual
- True Positioning Dimensioning

Extent of OJT programs.--The extent of the regional on-the-job educational programs according to the hours-per-week alloted for instruction as well as lengths of the training periods is described as follows:

Area 1.--Thirty-nine percent (11 firms) of the participating concerns (28 firms) in East Texas sponsored on-the-job instructional programs for drafting personnel. The mean total number of hours of the training programs in East Texas was 162.80 hours. The range of instructional time was from one to twenty hours-per-week with a mean of 8.5 hours-per-week. The duration of the training periods ranged varied from thirty days to four months.

Area 2.--Thirty percent (25 firms) of the participating concerns (82 firms) in North Central Texas employed some type of on-the-job educational training. The mean total number of hours devoted to instruction in North Central Texas was 291.42 hours. The range of instructional time was from one to forty hours-per-week with a mean of 23.05 hours-per-week. Training programs ranged from two weeks to two years in duration.

Area 3.--Twenty-eight percent (7 firms) of the participating concerns (25 firms) in Central Texas sponsored educational programs for drafting personnel. The mean total number of hours of training programs in Central Texas was 450.69 hours. The range of instructional time was from two to forty hours-per-week with a mean of 16 hours-per-week. The lengths of the training programs ranged from two weeks to nine months.

Area 4.--Twenty-four percent (4 firms) of the participating concerns (17 firms) in the Panhandle Plains conducted on-the-job training classes. The mean total number of hours devoted to instructional programs in this area was 175.67 hours. The range of instructional time was from one to forty hours-per-week with a mean of 13.38 hours-per-week. Training programs ranged from three months to one year in duration.

Area 5.--Educational inservice training was utilized by twenty-three percent (5 firms) of the participating firms (22) in West Texas. The mean total number of hours for instructional training was 537.20 hours. The range of instructional time was from four to forty hours-per-week with a mean of 19.67 hours-per-week. Industrial training lasted from three months to a year.

Area 6.--Twenty-eight percent (34 firms) of the participating area concerns (120 firms) in the South Texas-Gulf Coast Region sponsored instructional programs. The mean total number of hours alloted for industrial training was 555.33 hours. The range of instructional time was from one to forty hours-per-week with a mean of 25.44 hours-per-week. Lengths of training varied from two weeks to two years.

Area 7.--Forty percent (14 firms) of the out-of-state concerns

(35 firms) sponsored some type of in-service instructional program for drafting personnel. The mean total number of hours for instruction was 310.30 hours. The range of instructional time was from one to forty hours-per-week with a mean of 15.40 hours-per-week. Industrial training ranged from six weeks to three years in duration.

The mean total number of hours alloted for company sponsored on-the-job educational training was 388.45 hours. The mean total number of hours devoted to on-the-job training classes for all geographical regions are compared in Figure 87. The statistical data do not reflect the educational trends of the industrial concerns which indicated indefinite periods of training, International Correspondence Training, self-study courses, and continuous in-service training through the process of job rotation.

Industrial need for graduates of two-year programs.--There was a consensus among survey respondents regarding the employment potential for graduates of a two-year technology program. Ninety-three percent (306 firms) reported a need for such a program, while only three percent (11 firms) of the respondents reacted in a negative manner to the question (Figure 88).

Apprenticeship training.--Sixty-eight percent (223 firms) of the 329 surveyed companies did not sponsor any type of

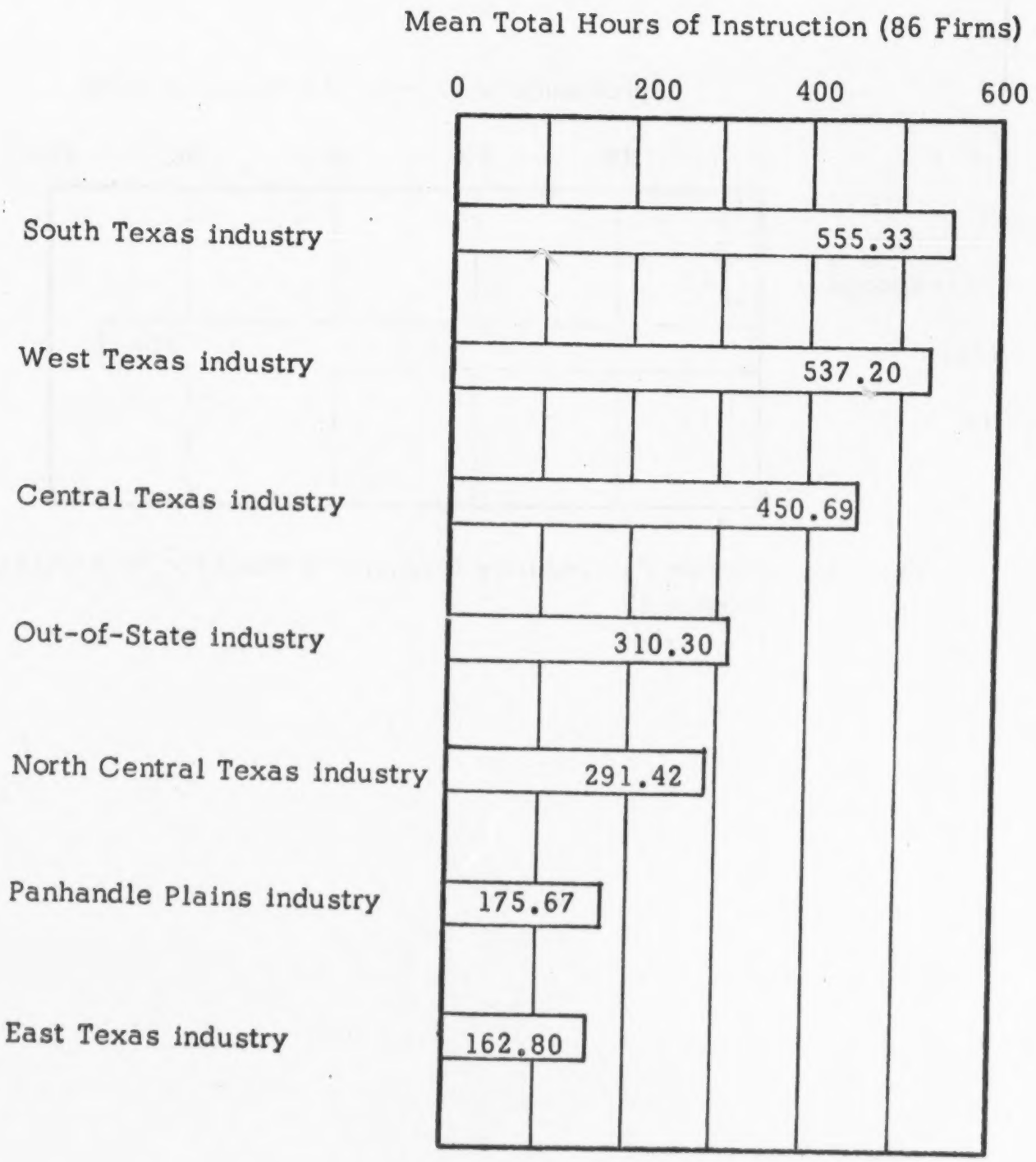


Fig. 87 --Mean Total Number of Hours Devoted to Company Sponsored On-the-Job Training Programs

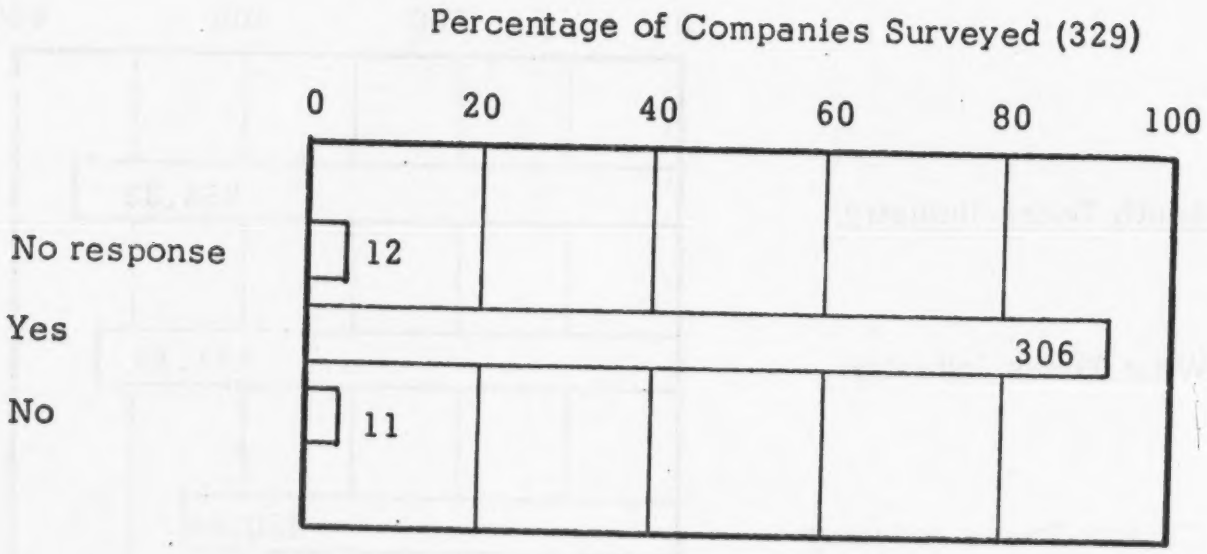


Fig. 88 --Opinions of Industry Concerning Need for Technician Programs

apprenticeship program for accepting, counseling, and training novice drafting personnel. Apprenticeship programs were sponsored by twenty-two percent (73 firms) of the 329 surveyed companies. The extent of the apprenticeship program is shown in Figure 89.

Job classifications and salaries.--Companies were requested to specify the grade levels of job classifications as well as the approximate monthly (1) starting, (2) average, and (3) maximum salaries for each classification plateau. An analysis of the pilot study disclosed that some personnel directors were hesitant to release actual salary figures, which were classified as confidential information by the company, and avoided responding to an open-ended question. To circumvent this problem, salary ranges were derived from established pilot study parameters and coded in appropriate class intervals. The code classifications as derived from the pilot study is as follows:

CODE	
A	Under $400
B	$400 to $567
C	$567 to $734
D	$734 to $900
E	Over $900

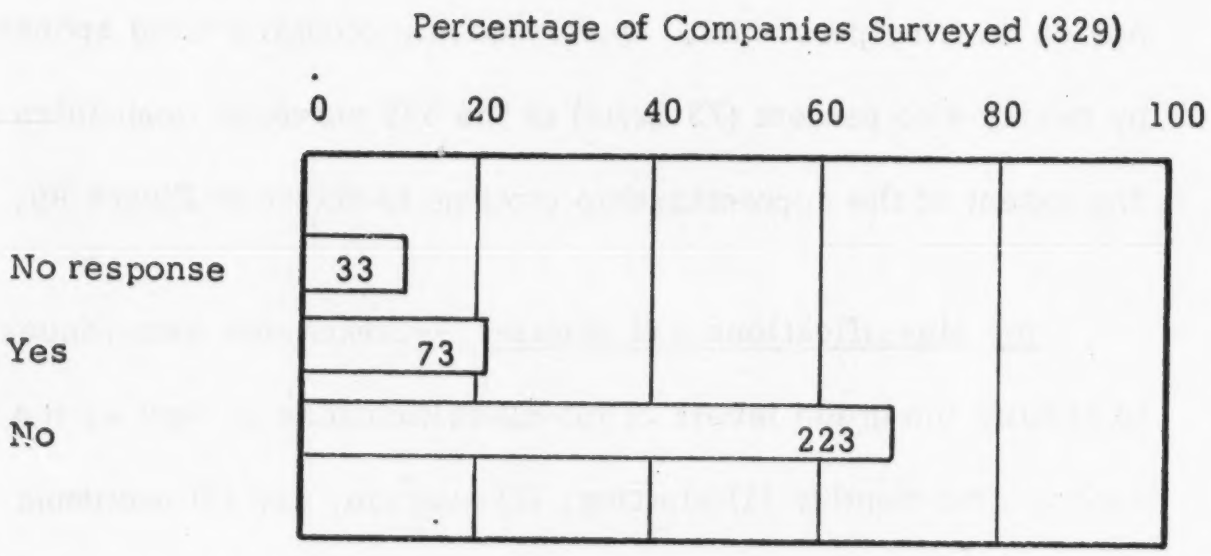


Fig. 89 --Apprenticeship Programs Conducted by Industry

The information gleaned from the coded responses is graphically presented in Figure 90. The left side of the chart shows the number of companies employing a specified number of job classification levels. The median monthly salaries for starting, average, and maximum plateaus are plotted in sequential arrangement on the right side of the illustration. Since these data were tabulated in class intervals, the median was selected as the unit of statistical measure. The median, according to Van Dalen (1966), offers the best description of the middle of a skewed distribution and is considered to be the most representative measure of central tendency (p. 336).

As an example of chart interpretation, item two shows sixty companies utilizing two levels of job classifications. The median starting, average, and maximum salaries at the second level in respective order are $501.39, $657.46, and $775.50. Salary figures for all levels of job classifications are listed in Appendix C.

Employment, projected needs, and yearly turnover.-- Each concern was requested to indicate the present number of draftsmen employed, relevant areas of specialization, estimated needs for both two and four year projections, as well as the yearly turnover. It was apparent on examining the research data that many of the respondents misinterpreted the questions concerning the two and four year

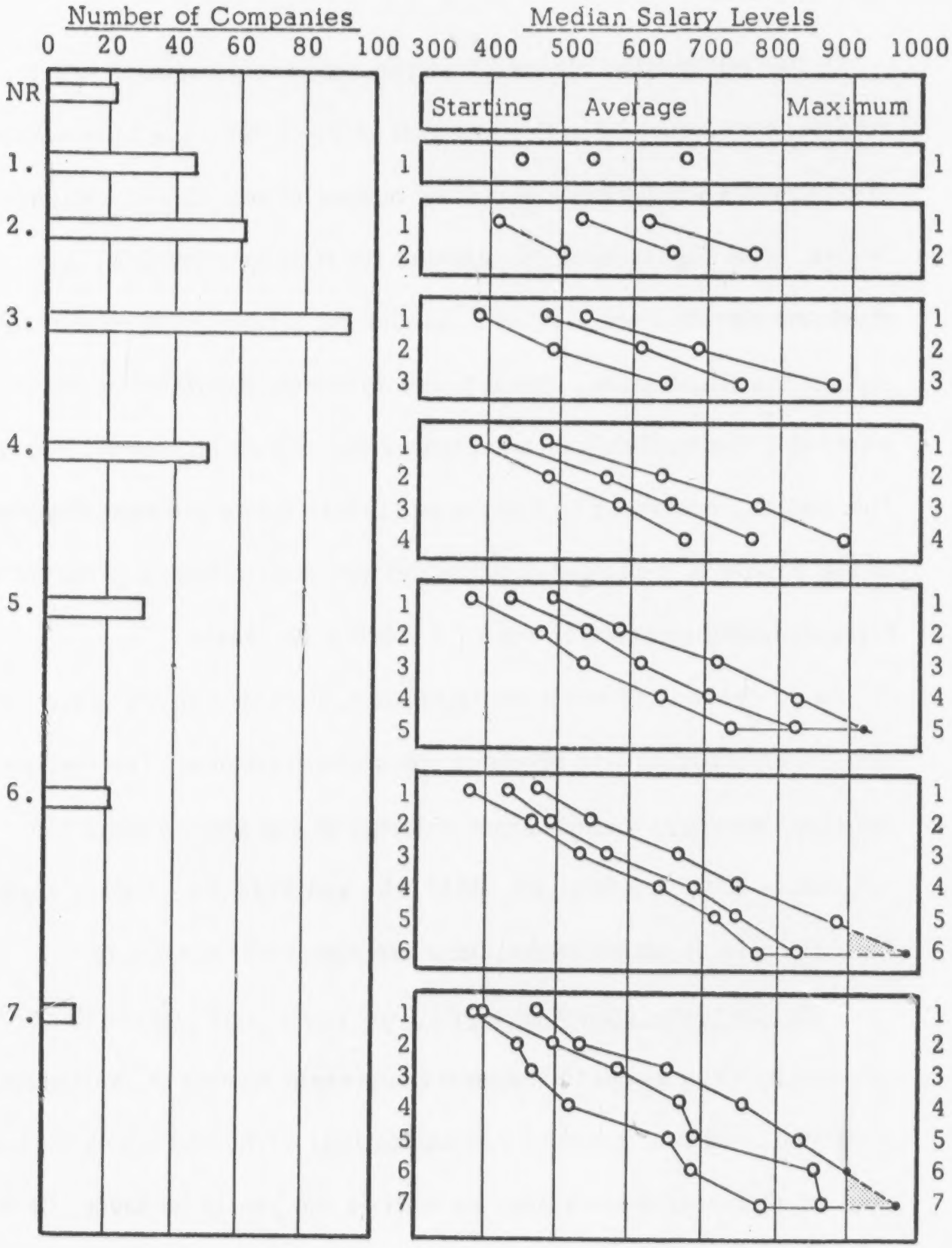


Fig. 90 --Job Classifications and Median Salary Levels

projections of employment trends. Therefore, these data were deleted from the report.

The tabulations for the number of draftsmen employed and yearly turnover for Texas industry (294 firms) are ranked in Figure 91 The five top ranking areas of specialization in Texas were (1) mechanical, (2) structural, (3) electro-mechanical, (4) civil, and (5) piping.

Top ranking areas of specialization in East Texas were (1) mechanical, (2) civil, (3) electro-mechanical, (4) electrical, and (5) structural. The number of draftsmen employed and yearly turnover for East Texas industry (28 firms) is shown in Figure 92.

Top ranking drafting specialties in North Central Texas were (1) mechanical, (2) electro-mechanical, (3) civil, (4) structural, and (5) technical illustration. The ranking specialties in North Central Texas industry (82 firms) are compared in Figure 93.

The specialties at the top of the rankings in Central Texas were (1) structural, (2) map, (3) electro-mechanical, (4) architectural, and (5) mechanical. The number of draftsmen employed and yearly turnover for Central Texas industry (25 firms) are shown in Figure 94.

Top ranking specialties in the Panhandle Plains area were

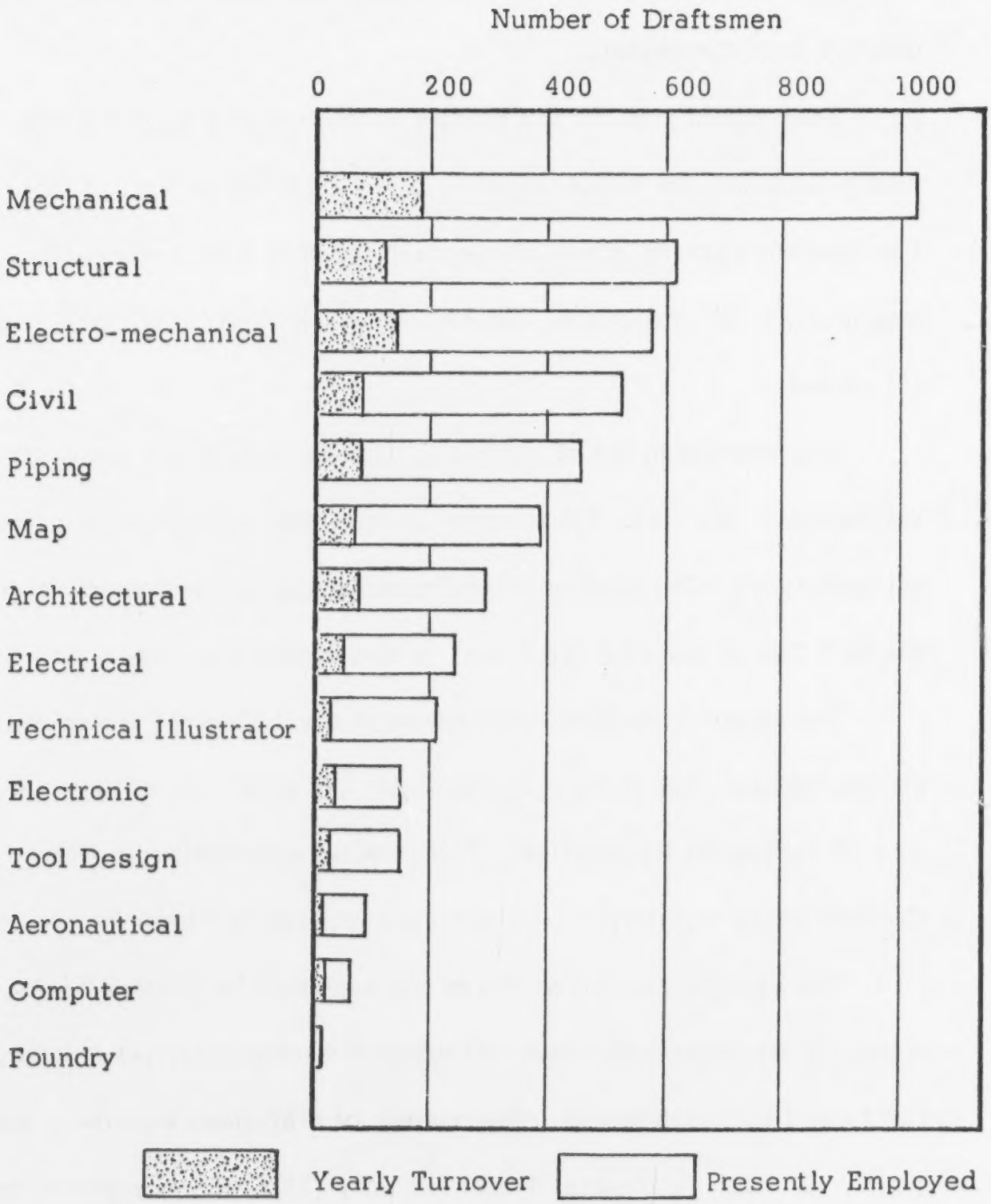


Fig. 91 -- Number of Draftsmen Employed and Yearly Turnover for Texas (294 Concerns)

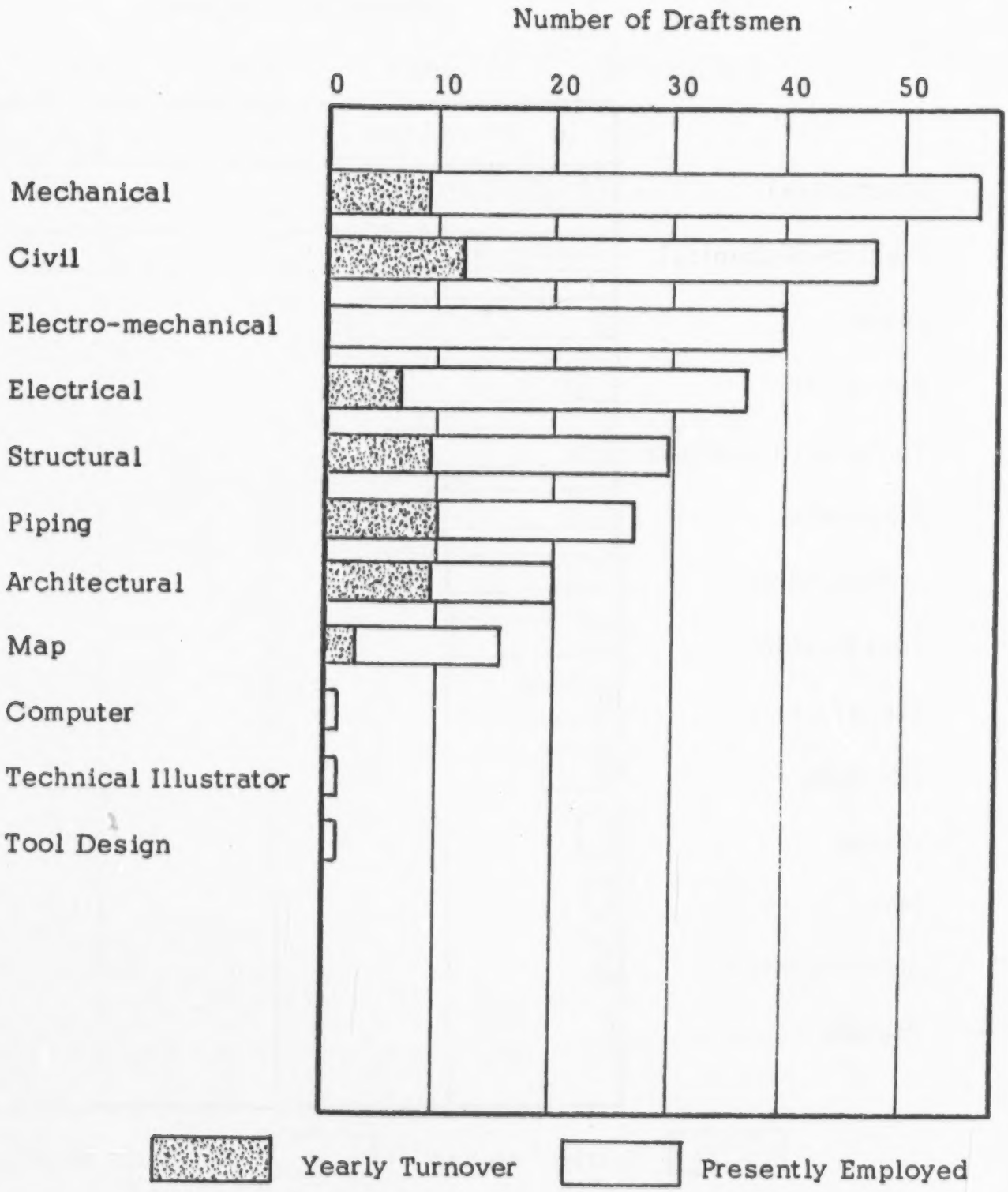


Fig. 92 -- Number of Draftsmen Employed and Yearly Turnover for East Texas (28 Concerns)

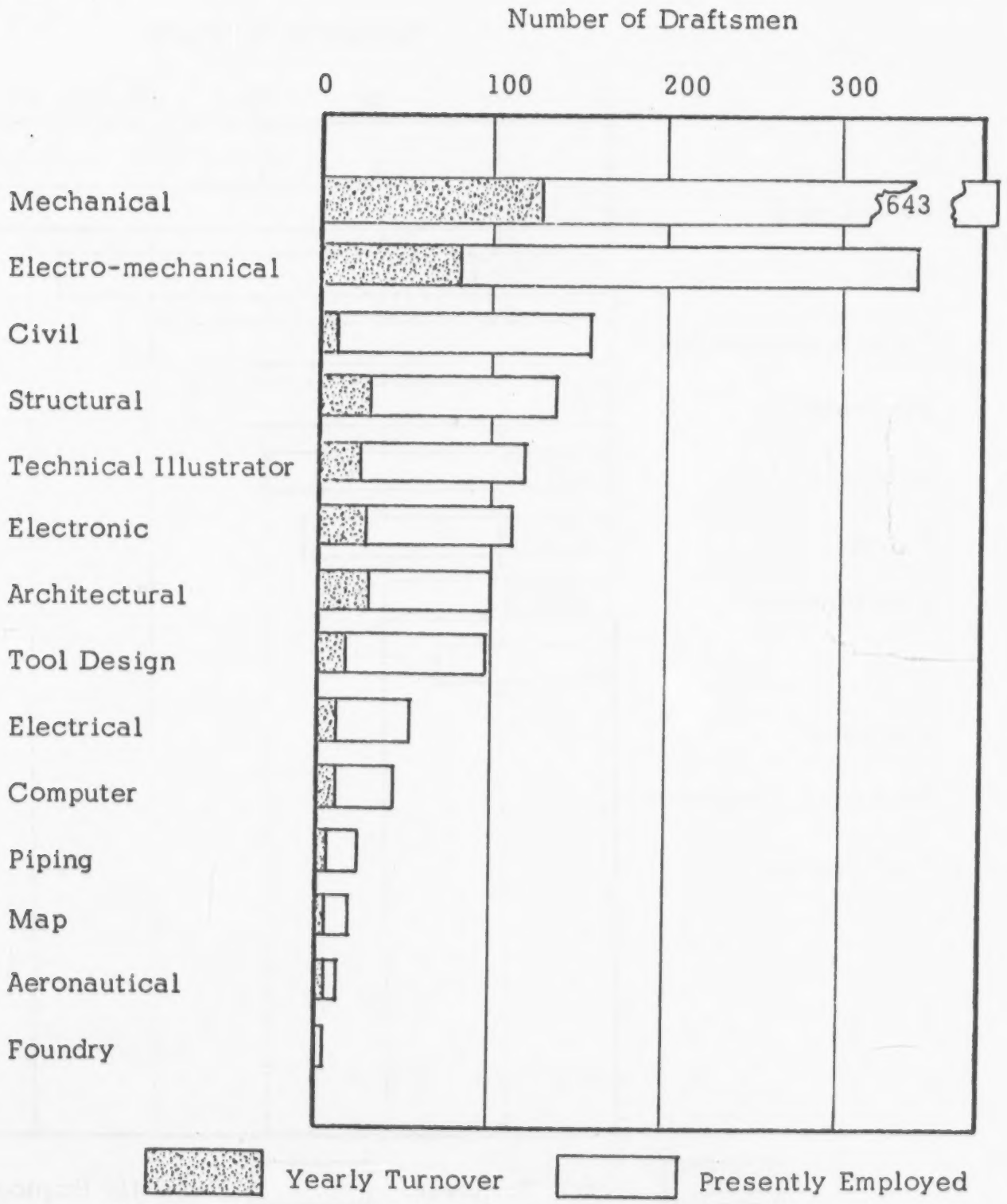


Fig. 93 -- Number of Draftsmen Employed and Yearly Turnover for North Central Texas (82 Concerns)

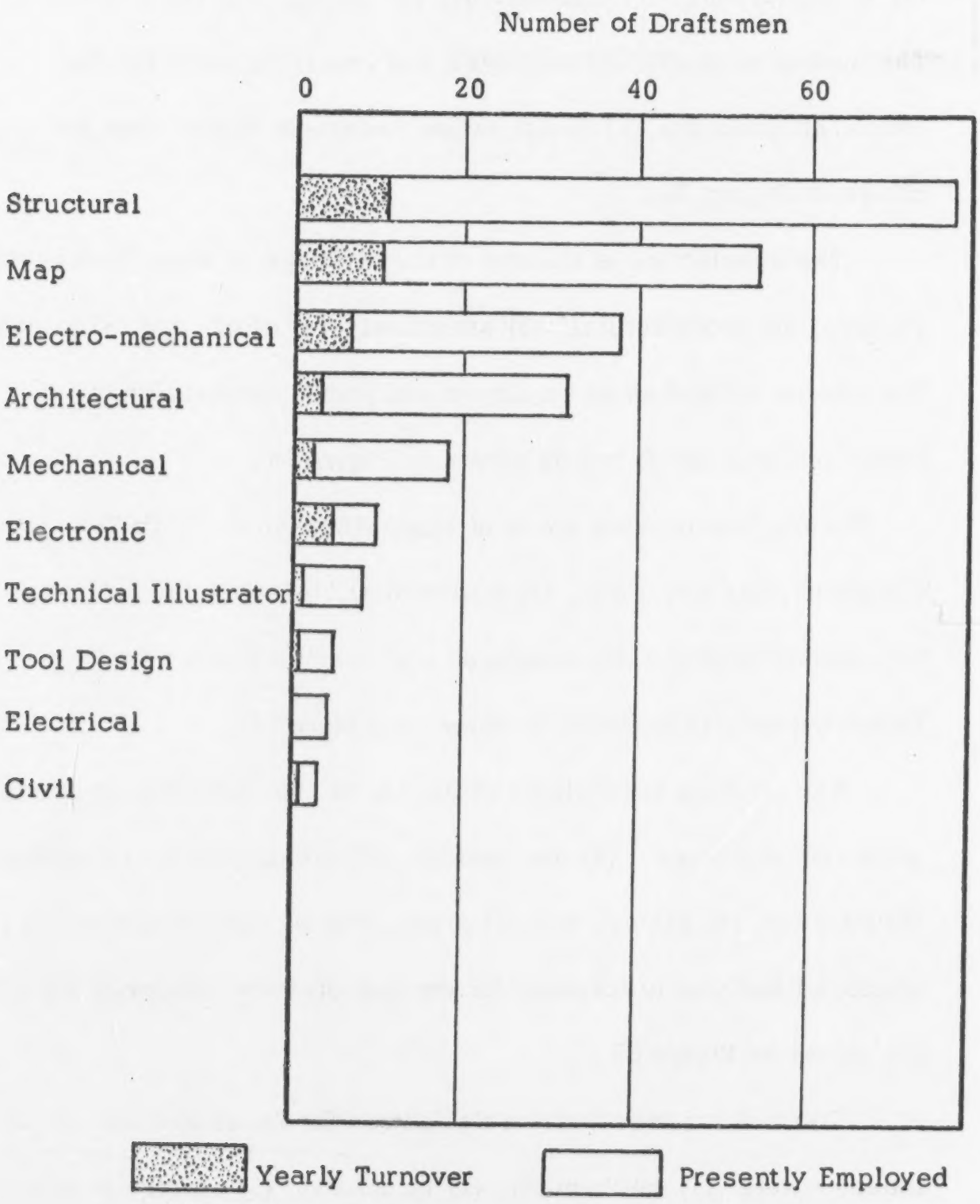


Fig. 94 -- Number of Draftsmen Employed and Yearly Turnover for Central Texas (25 Concerns)

(1) civil, (2) map, (3) mechanical, (4) piping, and (5) structural. The number of draftsmen employed and yearly turnover for the industrial concerns (17 firms) in the Panhandle Plains area are shown in Figure 95.

The specialties at the top of the rankings in West Texas were (1) map, (2) architectural, (3) structural, (4) civil, and (5) piping. The number of draftsmen employed and yearly turnover for West Texas industry (22 firms) is shown in Figure 96.

The top five ranking areas of specialization in South Texas were (1) piping, (2) structural, (3) mechanical, (4) civil, and (5) map. The number of draftsmen employed and yearly turnover for South Texas industry (120 firms) is shown in Figure 97.

The drafting specialties at the top of the rankings for out-of-state industry were (1) mechanical, (2) architectural, (3) technical illustration, (4) piping, and (5) civil. The number of draftsmen employed and yearly turnover for the out-of-state concerns (35 firms) are shown in Figure 98.

Top ranking areas of specialization for Texas and out-of-state industry were (1) mechanical, (2) structural, (3) electro-mechanical, (4) civil, and (5) piping. The number of draftsmen employed and yearly turnover for Texas and out-of-state industry (329 firms) are

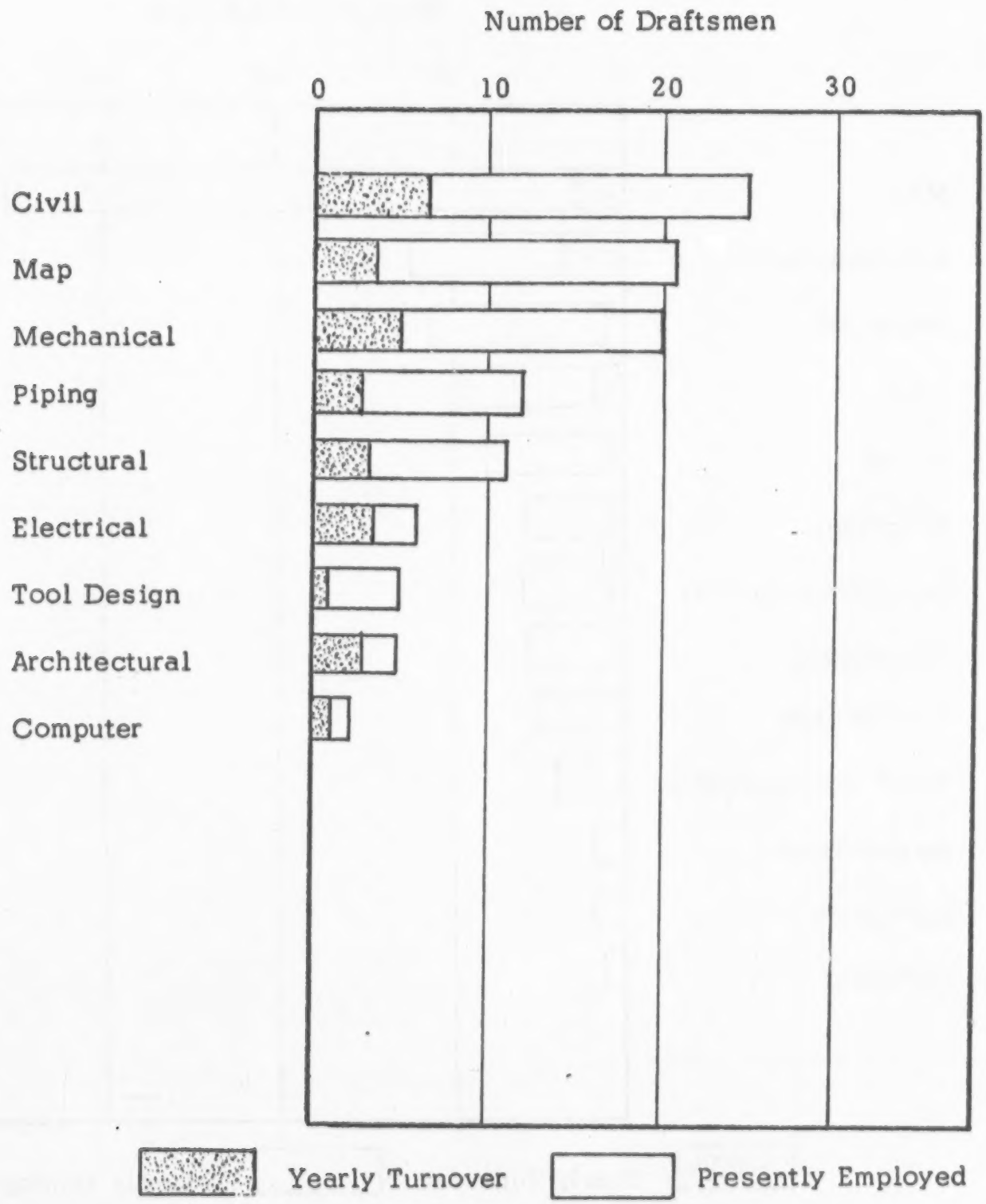


Fig. 95 -- Number of Draftsmen Employed and Yearly Turnover for the Panhandle Plains (17 Concerns)

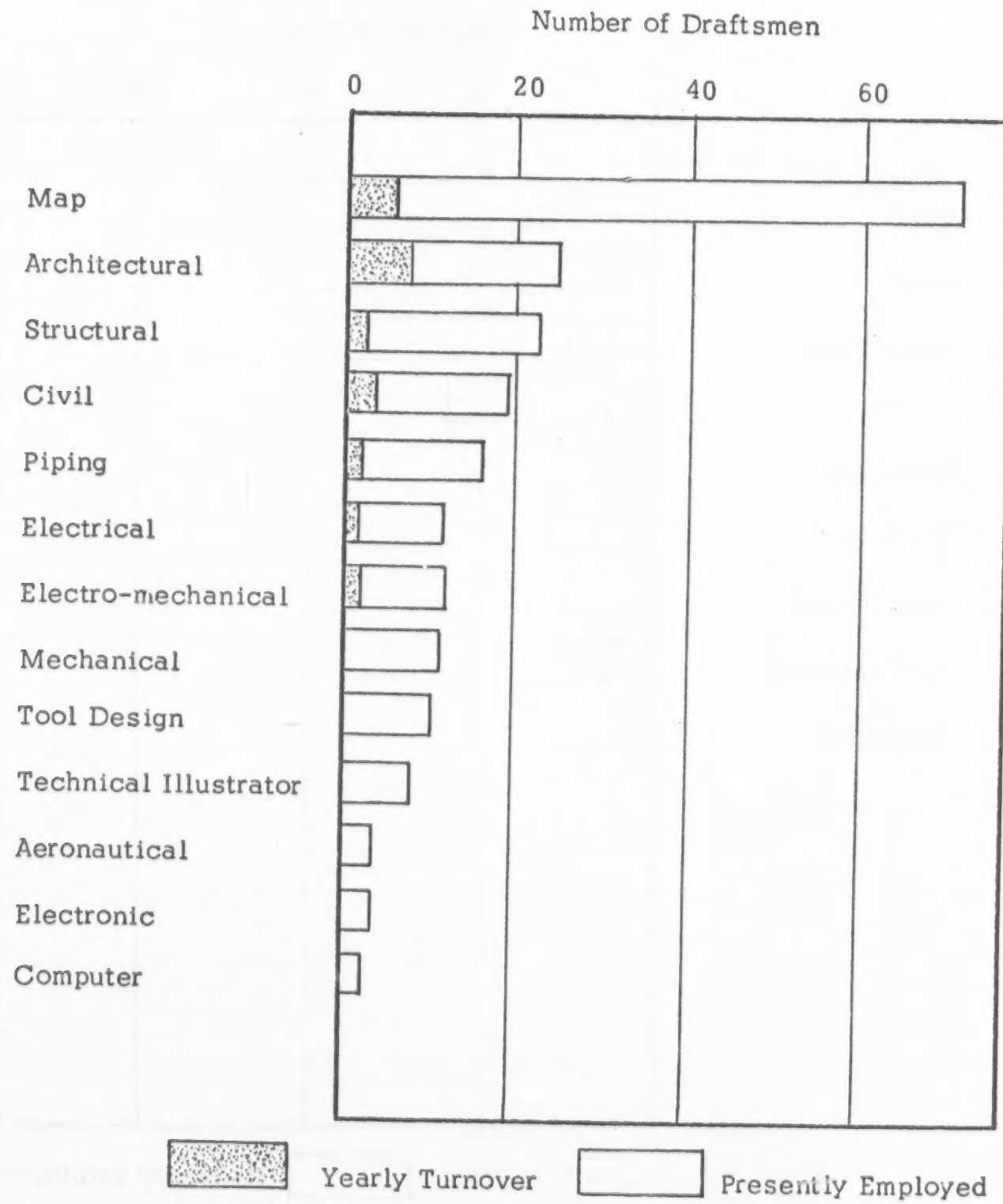


Fig. 96 -- Number of Draftsmen Employed and Yearly Turnover for West Texas (22 Concerns)

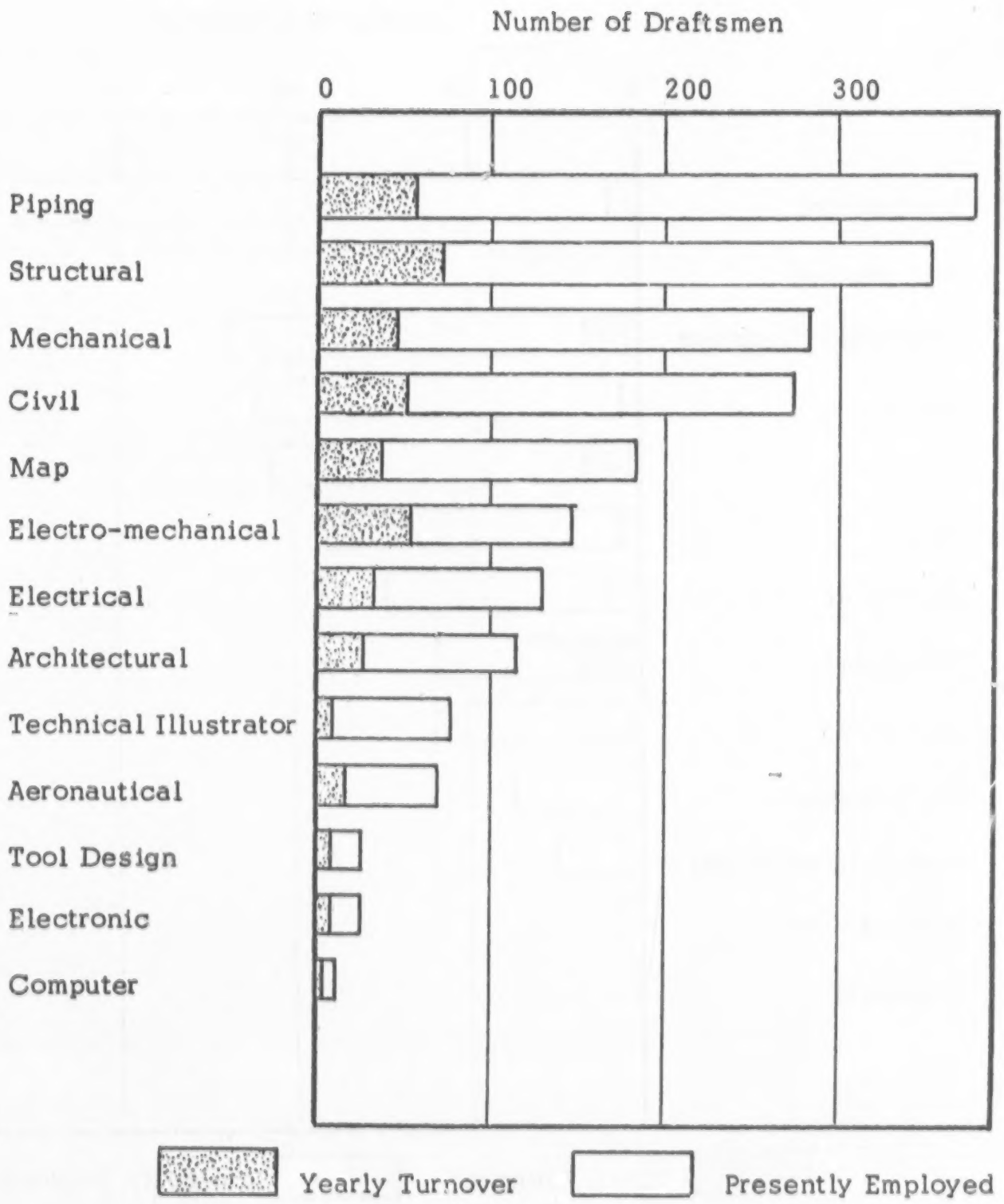


Fig. 97 -- Number of Draftsmen Employed and Yearly Turnover for South Texas (120 Concerns)

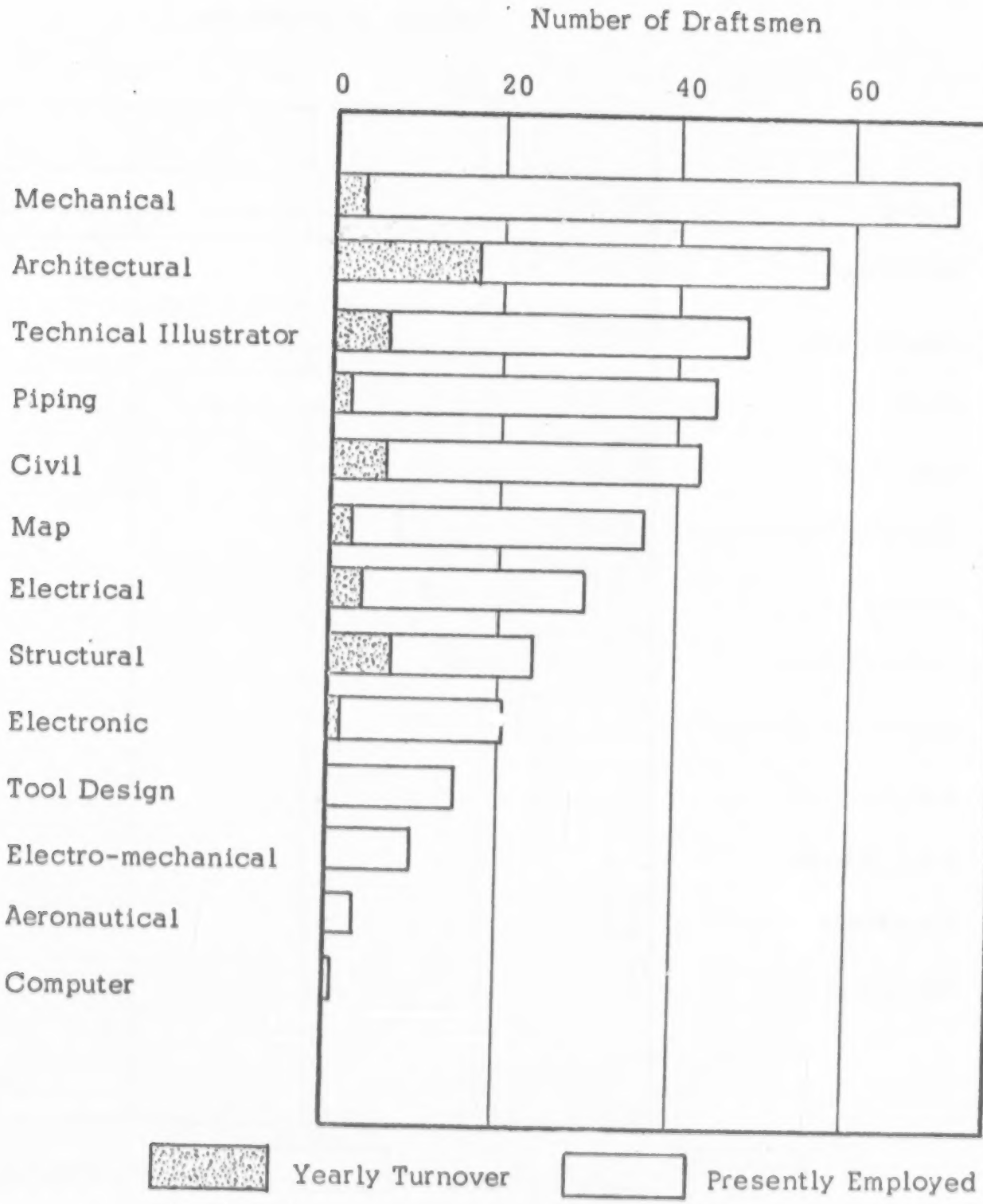


Fig. 98 -- Number of Draftsmen Employed and Yearly Turnover for Out-of-State Industry (35 Concerns)

shown in Figure 99. These graphs offer some insight into the major industrial specialties areas for each region as well as the ranking specialties in the state..

Technician employment.--Fifty-one percent (168 firms) of the 329 surveyed companies employed graduates or students of two year drafting technology programs. Two year graduates were not employed by forty-seven percent (153 firms) of the industrial concerns indicating a source of untapped job opportunities in industry for graduates of drafting technology programs (Figure 100).

Proficient areas of specialization.--Respondents were requested to indicate the drafting specialties in which the technology graduates were most proficient and also the areas of specialization in which the graduates were least proficient. The relative proficiency of technology program graduates according to regional appraisal is shown below:

Region	Proficient Area	Deficient Area
East Texas	mechanical	electrical
North Central Texas	mechanical, civil ----	electronic printed circuit board design
Central Texas	mechanical	------
The Panhandle Plains	mechanical	electrical
West Texas	mechanical	electrical
South Texas-Gulf Coast	mechanical ---------	structural detailing, electrical
Out-of-State	mechanical	--------

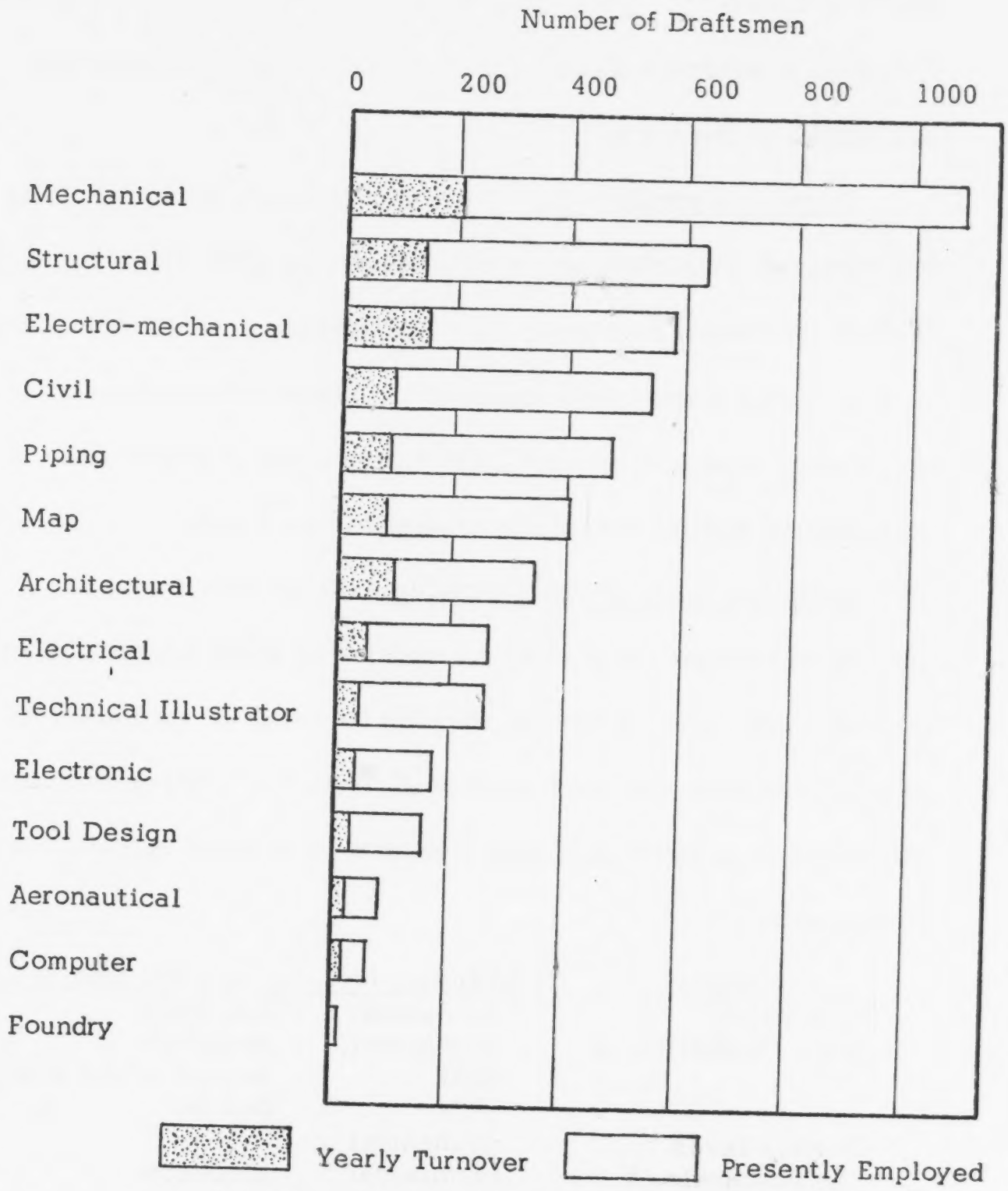


Fig. 99 -- Number of Draftsmen Employed and Yearly Turnover for Texas and Out-of-State Industry (329 Concerns)

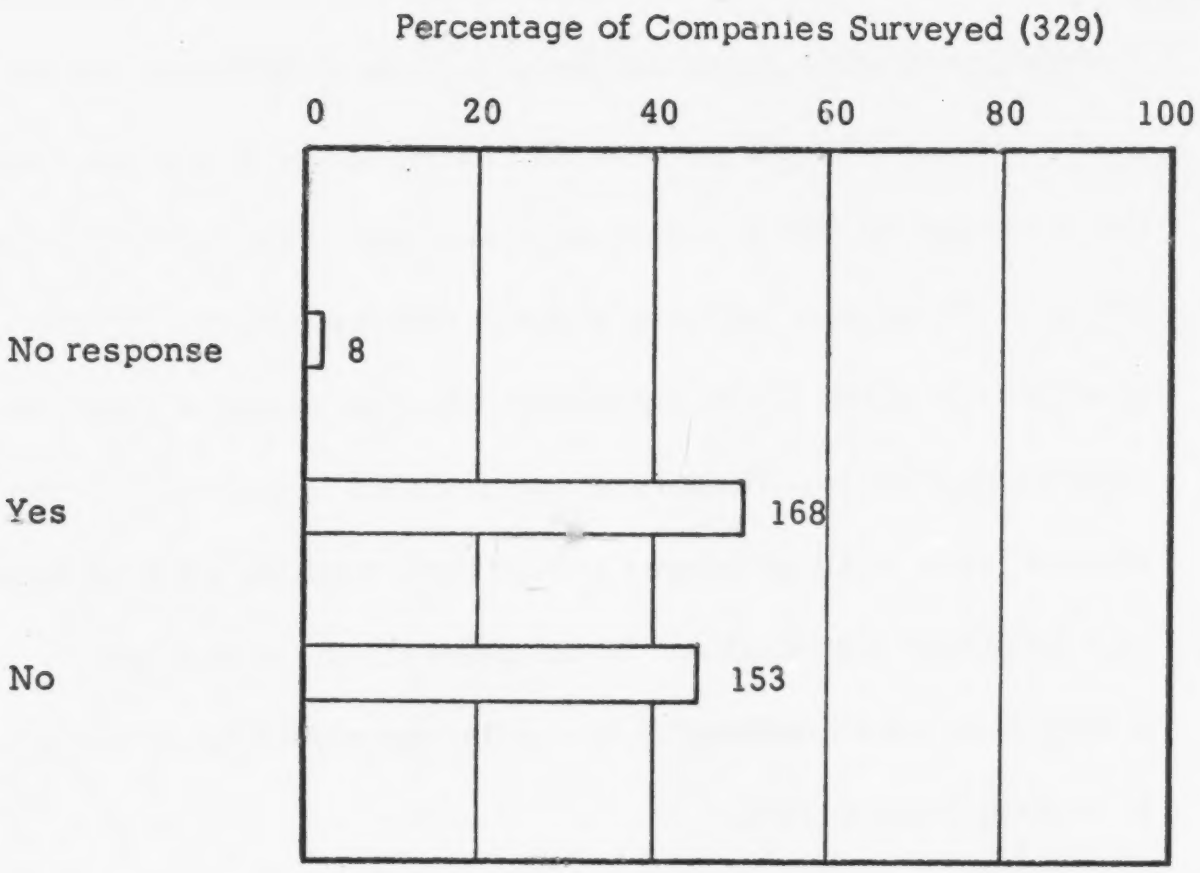


Fig. 100 --Industrial Employment of Graduates of Two Year Drafting Programs

Proximity to campus locations.--Survey respondents were requested to indicate the approximate mileage from their company to the nearest state supported junior college or technical institute. Approximately fifty-six percent (184 firms) of the responses from the participating 329 concerns indicated that plant locations were within a fifteen mile radius of a junior college campus. Thirty percent (100 firms) of the plant locations were within a five mile radius of a campus. Plant locations in terms of proximity to the nearest junior college campus or technical institute were arranged in a frequency distribution. Class intervals in the charted distribution were tabulated in five mile increments for convenience in reading (Figure 101).

Junior college utilization of industrial resources.-- To determine the extent that junior colleges were utilizing industrial resources, and to estimate the degree of communication between industry and local institutions, respondents were requested to indicate the degree to which they were consulted in curriculum planning. Eighty-four percent (275 firms) of the responses from the 329 surveyed companies indicated that junior college representatives had not submitted requests to company representatives for assistance in curriculum planning. Twelve percent (39 firms) of the responses

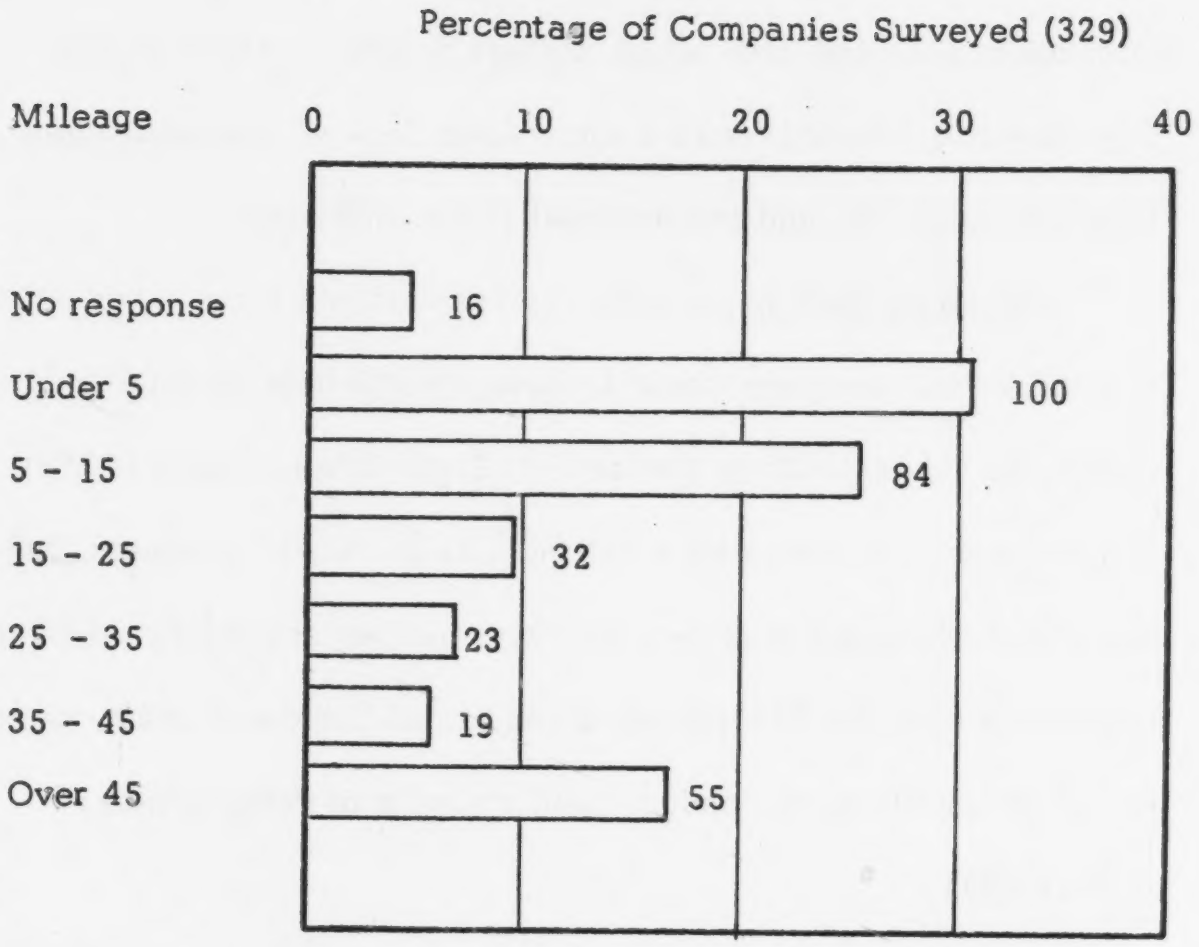


Fig. 101--Approximate Mileage from Industrial Concerns to The Nearest Junior College or Technical Institute

indicated that the company had received requests for assistance in curriculum planning from junior college representatives (Figure 102). The research data indicates a significant lack of communication between industrial and institutional representatives.

Industrial field trips.--Survey respondents were asked, "Do you think your company would be receptive to hosting industrial field trips for technology classes?" Sixty-three percent (208 firms) of the responses indicated a willingness to "host" industrial field trips for technology classes. Twenty-nine percent (97 firms) of the responses from the 329 surveyed companies indicated their company would be unwilling to conduct field trips for drafting classes (Figure 103).

Workshop participation.--Survey respondents were asked, "Do you think your company would be receptive to participating in workshops to upgrade or implement junior college instructions?" Fifty-nine percent (193 firms) of the respondents of 329 surveyed companies signified a willingness to participate in workshops. Thirty percent (39 firms) of the responses indicated an unwillingness for workshop participation (Figure 104).

Industrial consultants.--Each company was requested to list "qualified" personnel who would be receptive to serving as a guest

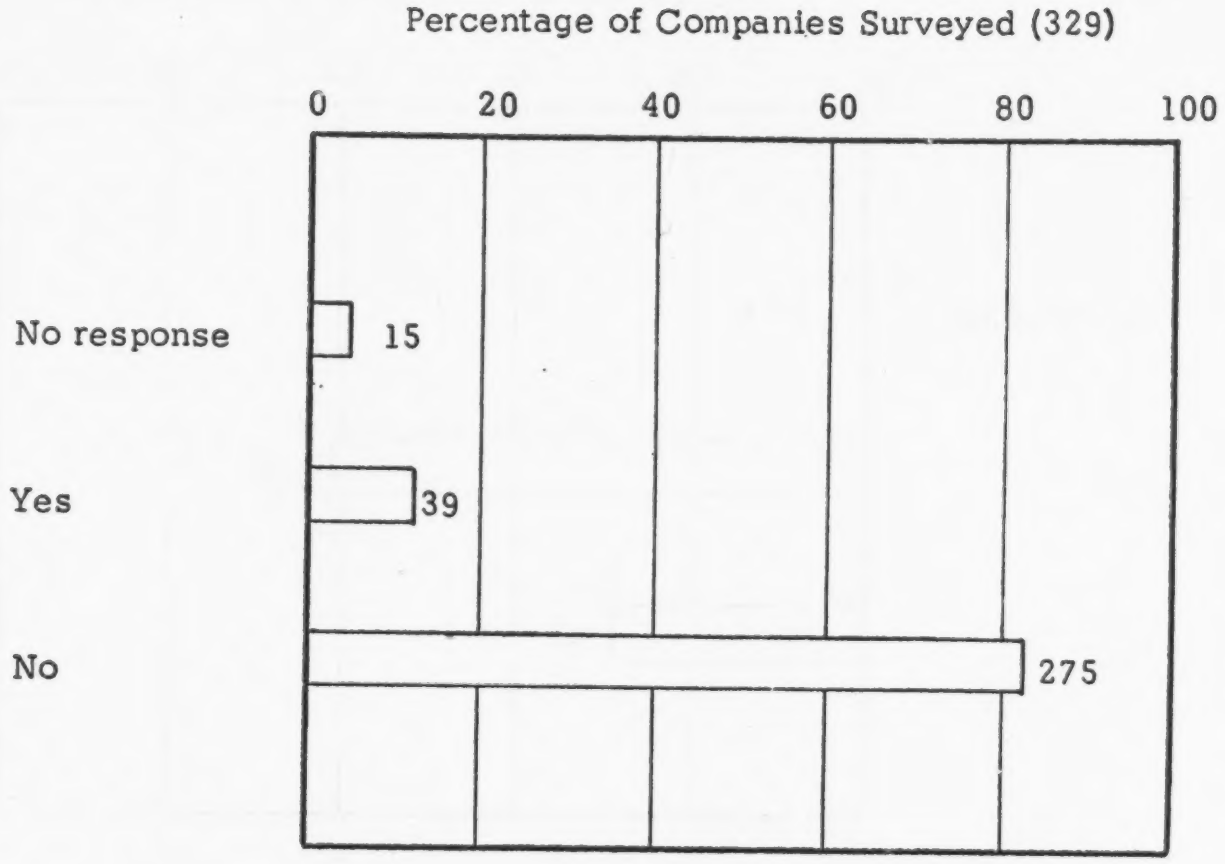


Fig. 102--Number of Industrial Concerns Receiving Requests from Junior College Representatives for Assistance in Curriculum Planning

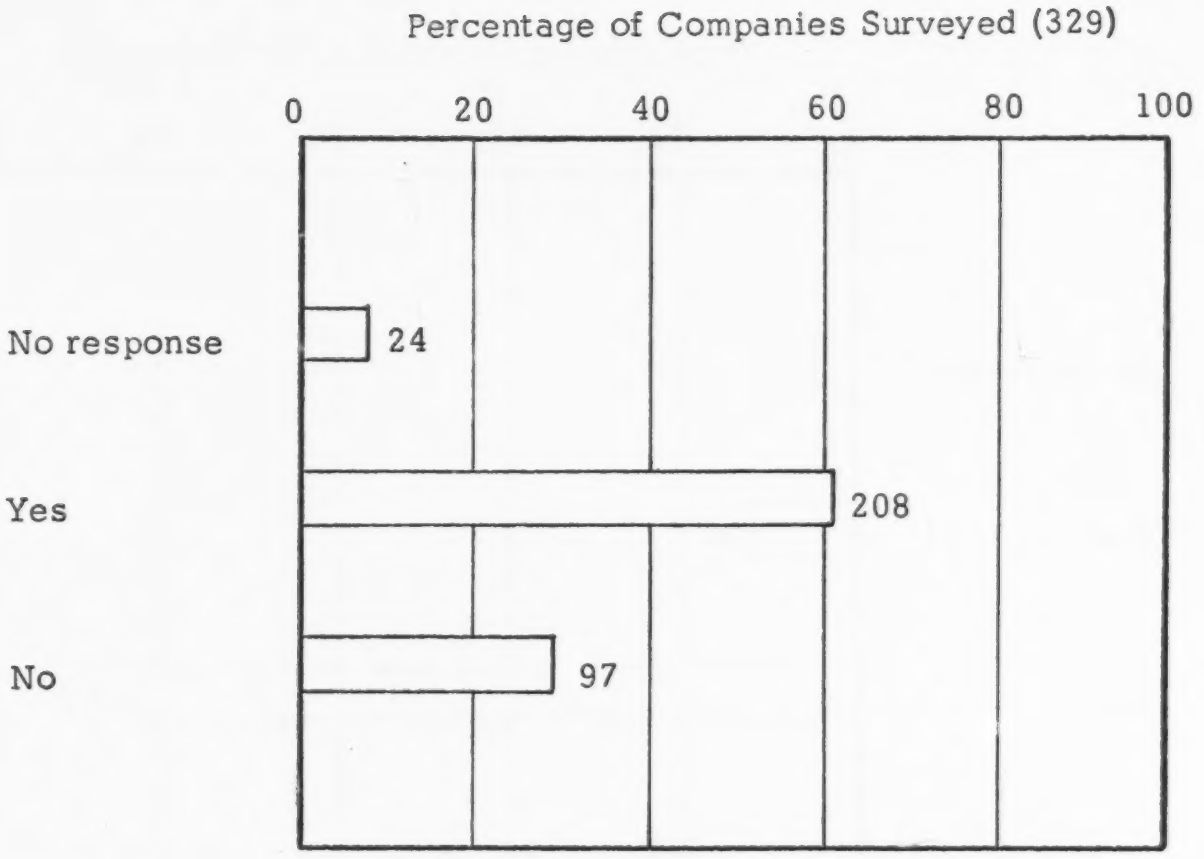


Fig. 103--Number of Industrial Concerns Willing to Conduct Industrial Field Trips for Drafting Classes

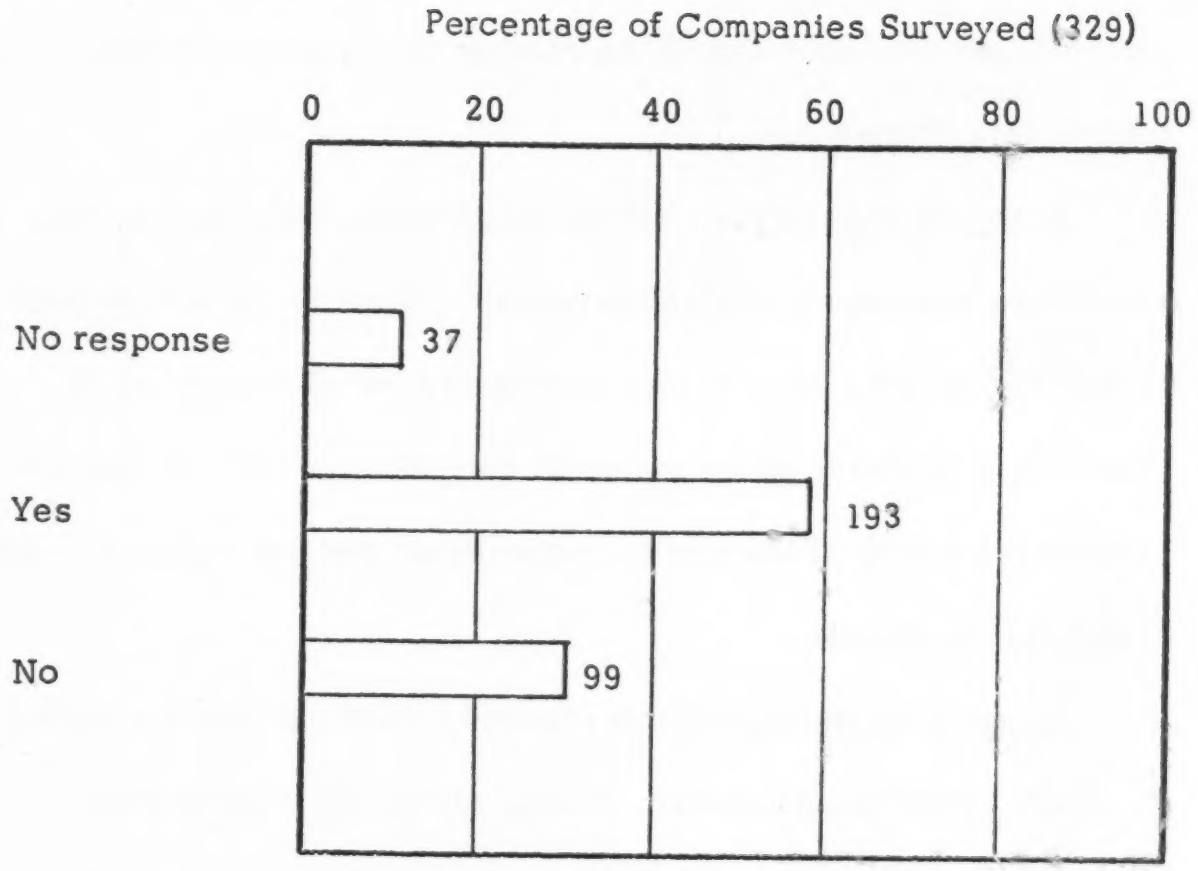


Fig. 104--Number of Industrial Concerns Willing to Participate in Workshops to Upgrade or Implement Junior College Drafting Classes

lecturer, resource consultant, or in some advisory capacity to "local" junior college programs. The tentative industrial participation is shown according to the number of regional volunteer consultants (Figure 105).

Research summary.-- Survey respondents were asked, "Do you desire a summary of this research?" Seventy-seven percent (254 firms) of the company representatives were interested in obtaining a summary of the research data (Figure 106). Seventeen percent (55 firms) of the survey respondents did not want a summary of the survey results.

Application forms.-- Each personnel manager was requested to attach to the questionnaire, a copy of the application form utilized by applicants for drafting positions. The majority of application forms which were received were standard company application forms which were utilized by all tentative company employees. Therefore, no significant data which applied specifically to drafting personnel were extrapolated from these forms.

General Drafting Specialty

A paramount objective of this research was to determine requisites for curriculum content which would be applicable to most

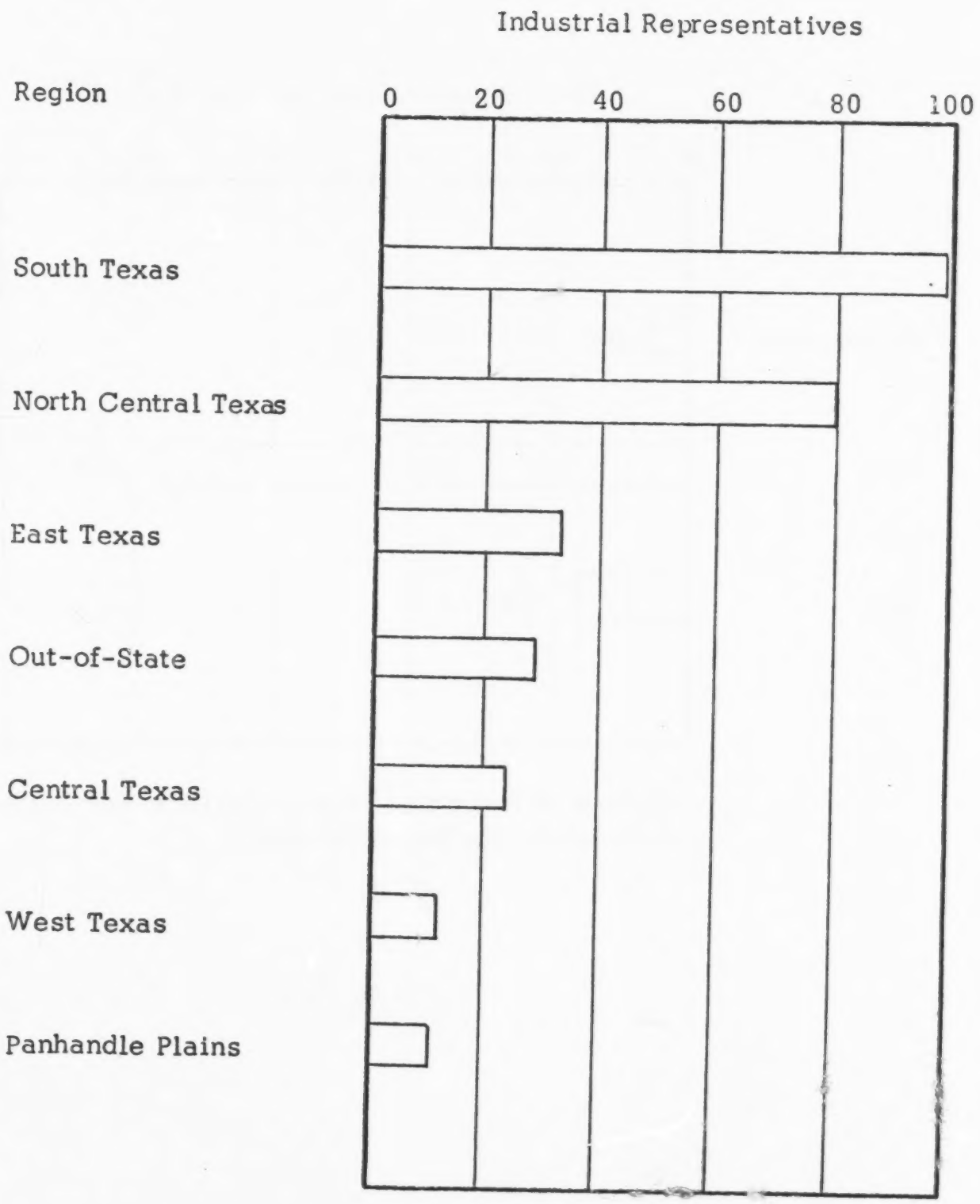


Fig. 105--Number of Industrial Representatives Willing to Serve as a Guest Lecturer, Resource Consultant, or in Some Advisory Capacity to Local Junior College Programs

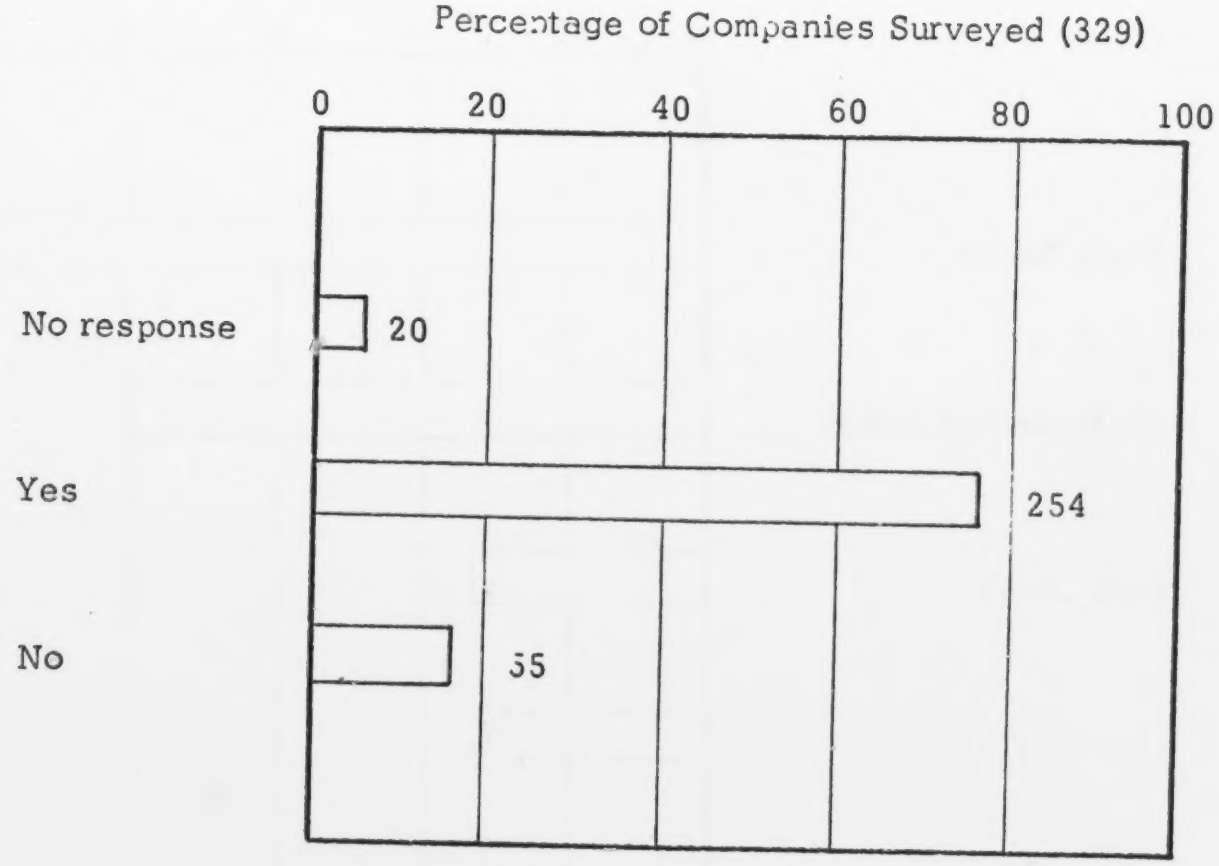


Fig. 106--Number of Industrial Representatives Wanting a Summary of the Survey Results

fields of drafting specialization, thereby establishing a nucleus of course material for the basic drafting technology drawing courses. Items were selected which were considered to be common to most areas of drafting technology, regardless of specialty. These items were incorporated into a general insert to supplement all specialty questionnaires. The criteria and directions for rating questionnaire topics according to a ten-point rating scale is explained in Appendix C. Statistical analysis of the topic ratings is presented graphically for ease of interpretation in the form of standard deviations and mean values. The dots on the line graph are plotted mean values. The shaded horizontal bar represents the corresponding standard deviation. The lengths of the standard deviation bars are drawn according to the divisions of the rating scale. A visual interpretation of the standard deviation bar is made by counting the rating scale columns on either side of the mean (dot). Thus, a shaded bar which extends two and one-half coulumns from the dot (mean) would represent a standard deviation of approximately 2.5, etc. In general, the shorter the length of the standard deviation bar, the closer the respondents were in agreement on the rating of the topic (Appendix C).

The analysis of the five-year projections is presented

graphically by mean values (dots) on the basis of a three-point continuum as defined by the "less", "same", and "more" columns adjacent to the rating scale. The "less", "same", and "more" heading at the top of the columns is the key to interpreting the five-year projections.

Statistical measurements for the General Draftsman Section of the questionnaire are based on the combined responses from a cosmopolitan group of seven hundred and thirteen field specialists. The distribution of responses according to the areas of specialization were:

Code	Specialization	Responses
1	Aeronautical	8
2	Architectural	95
3	Civil	86
4	Computer	13
5	Electrical, Electronic, Electro-Mechanical	85
6	Foundry	8
7	Map	58
8	Mechanical and Tool Design	112
9	Piping	57
10	Sheet Metal	36
11	Structural	111
12	Technical Illustration	44
	Total	713

The values of the instructional topics for the General Draftsman Section pertaining to specific fields of specialization as rated by field specialists are listed in tabular form (Appendix C). The code number or column heading is the key to reading the table.

A sequential arrangement of all questionnaire ratings as well as the relative five year projections is presented in graphical format in Appendix C. Suggested instructional topics for all information forms were randomly arranged to avoid suggesting any order of importance by the sequential format to the rater. Subclassifications were grouped with appropriate major topics in order to facilitate the completion of the questionnaire. In some cases, because of the format of the questionnaire, major topics were not evaluated by survey respondents. In such cases, a weighted mean was extrapolated from the subclassifications and assigned to the major topics. These cases are identified in the graphs in Appendix C by the lack of a shaded bar which represents the standard deviation.

The ratings of the major topics for each information form are ranked in descending order of the means to emphasize the industrial evaluations which were on the high end of the rating scale. The ranked instructional topics for the General Draftsman insert are shown in Figure 107. The standards which were included in the General Draftsman insert are arranged by mean values in Figure 108.

A "zero" rating indicates an instructional topic is either not used or is of no practical value to industry. Therefore, all of the ratings which are evaluated on the low end of the rating scale are

General Draftsman N=713

Use of dftg. machines, triangles, tools
Ability to make drawing revisions
Understand sections and conventions
Lay out working drawings
Apply simplified drawing practices
Understand multiview projection
Application of line conventions
Application of short cut dftg. methods
Use and treatment of auxiliary views
Use and treatment of std. abbreviations
Ability to letter
Preparation of assembly drawings
Ability to make freehand sketches
Use of scales
Application of design processes
Application of dimensioning practices
Use revolution for problem solving
Use geometric construction
Recognition of reproduction media
Solve developments and intersections
Representation of threads and fasteners
Develop charts, graphs, and nomograms
Lay out flow and critical path diagrams
Knowledge of shop processes
Problem solving by descriptive geometry
Ability to make pictorial drawings
Use models and model construction
Calculate and specify cams and gears

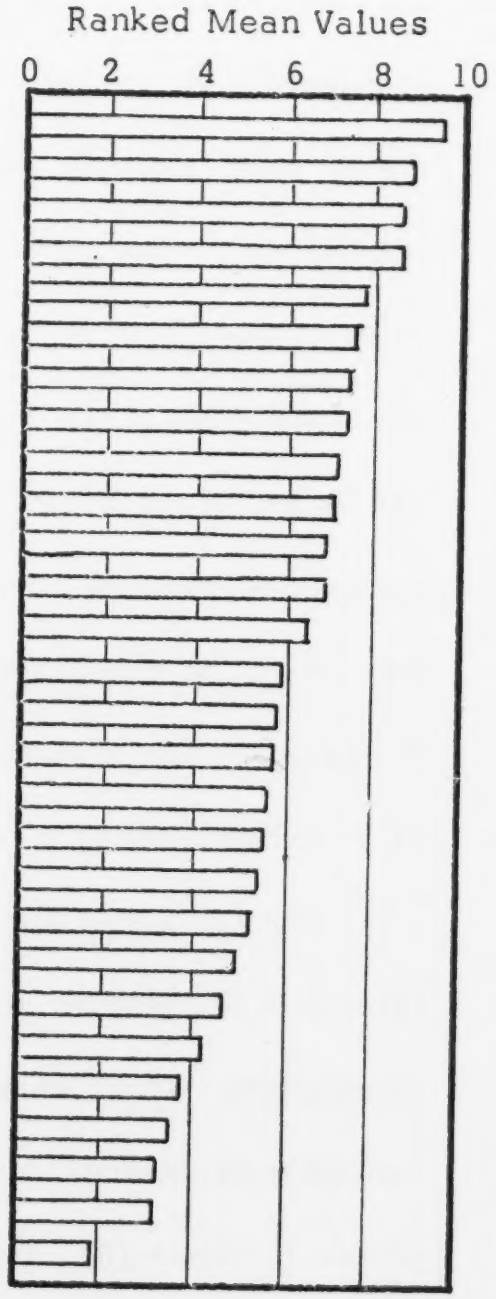


Fig. 107--Industrial Ratings for General Draftsman Section

Standards N=713

Use "Company Standards"
Use AISC Manual
Use Machinery Handbooks
Use ASA Standards
Use Sweet's Catalogs
Use Smoley's Combined Tables
Use CRSI Manual
Use SAE Standards
Use Military Standards

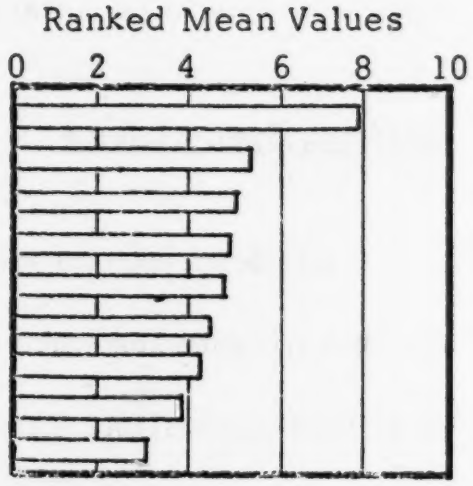


Fig. 108--Industrial Ratings for Standards Section

considered to be of little importance to industry. A review of the graphs leads the reseacher to believe that a cut-off or point of decision should be established at the 4.0 level on the rating scale.

Drafting Specialties

Job descriptions were written into the headings of all specialty forms to insure the completion of the questionnaire by an appropriate field specialist. Each specialty form was completed by a qualified industrial professional who was selected by a responsible company representative. An index to the total number of responses (N) as well as the number of regional responses (n) is listed with the job title heading in the chart presentations of all specialty rankings.

Aeronautical draftsman.--Research data for the aeronautical specialty were compiled from the responses of eight aeronautical draftsmen. Fifty percent (4) of the responses were from South Texas, twenty-five percent (2) were from North Central Texas, and twelve and one-half percent (1) were from Central Texas and West Texas industry.

The mean of the highest ranked item, "Understanding of dimensioning theory," was an 8.50 rating scale value. The mean of the lowest ranked item, "Drafting for microfilm reproduction,"

was a rating scale value of 6.12. The difference between the largest and smallest measurement was 2.38 indicating little variability in the industrial evaluation. The configuration of the graph illustrates evaluations were closely balanced. However, it would appear that the top eight items should receive slightly more instructional emphasis than the last eight topics (Figure 109).

Architectural draftsman. --Statistical measurements of the architectural specialty were calculated from the responses of one hundred specialists. Seventy-two percent (72) of these responses were received from North Central Texas, South Texas, and Out-of-State Industry.

The mean of the first item, "Preparation of architectural details," was a rating scale value of 9.19. The lowest item, "Ability to do cost accounting," was evaluated with a mean of 2.90. The difference between the largest and smallest measurement was 6.29 and shows large variability in the evaluations of the instructional topics.

The means of the top five items "Preparation of architectural details," "Use architectural symbols," "Architectural lettering skill," "Familiarity with building trades," and "Knowledge and application of materials" is an indication that these topics should

Aeronautical Draftsman

Region	1	2	3	4	5	6	7	N
n	0	2	1	0	1	4	0	8

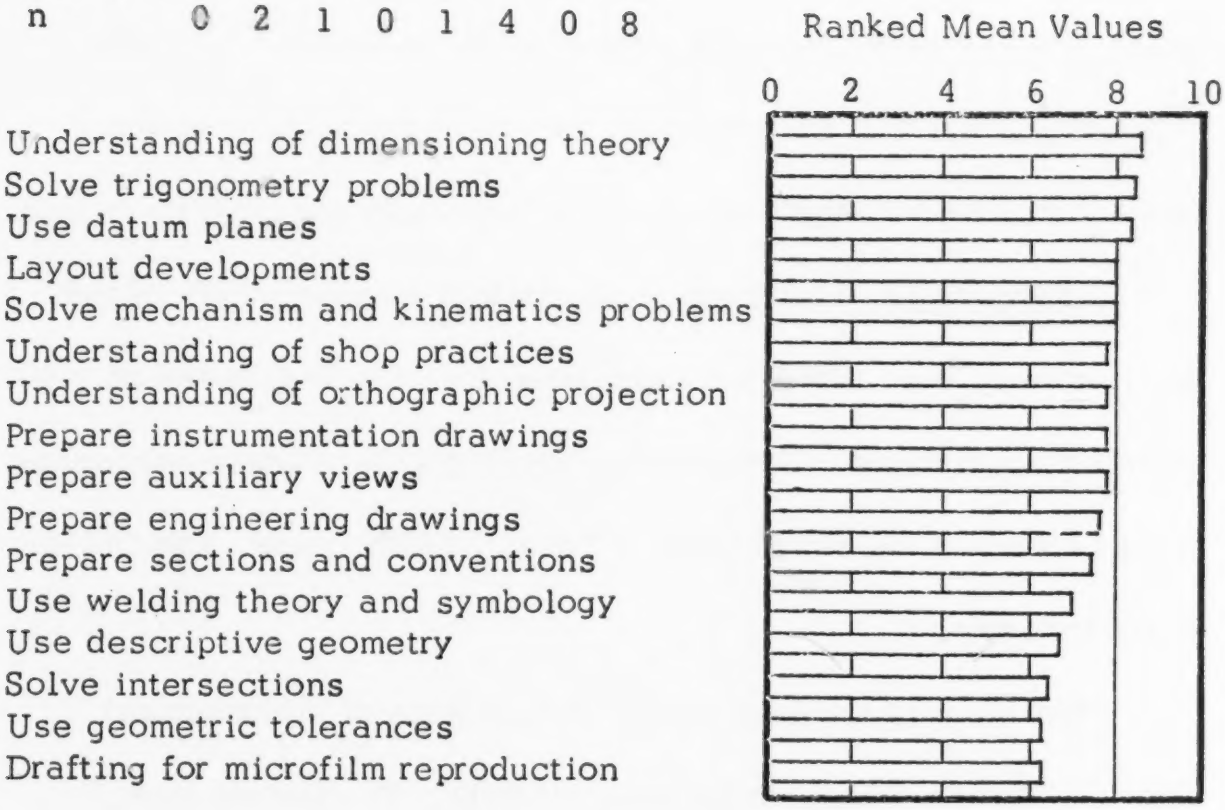


Fig. 109 --Industrial Ratings for Aeronautical Section

receive maximum emphasis in drafting classes. The center five items "Understanding of orthographic projection," "Knowledge of building codes," "Understanding of area planning," "Preparation of schedules for plans," and "Apply methods of modular construction" should receive some instructional emphasis. The pattern of the graph suggests that the lower ranked topics "Preparation of presentation drawings," "Ability to prepare cost estimates," "Use critical path schedules," "Know history of architecture," and "Ability to do cost accounting" require considerably less emphasis than the center five topics. The skewness of the chart strongly indicates that the top ranked topics have much more occupational value in industry than the lower ranked items (Figure 110).

Civil draftsman.-- The data for the civil specialty was based on eighty-six responses from civil draftsmen. Sixty percent (52) of the responses were from North Central Texas and South Texas industry. The mean of the highest ranked item, "Understanding of blueprint reading," was 8.84. The mean of the lowest ranked item, "Use stero-plotter," was 1.90 on the rating scale. The difference between the largest and smallest measurement (6.94) shows a large range of variability in the evaluations. The means of the top nine items "Understanding of blueprint reading,"

Architectural Draftsman

Region	1	2	3	4	5	6	7	N
n	10	23	7	2	9	29	20	100

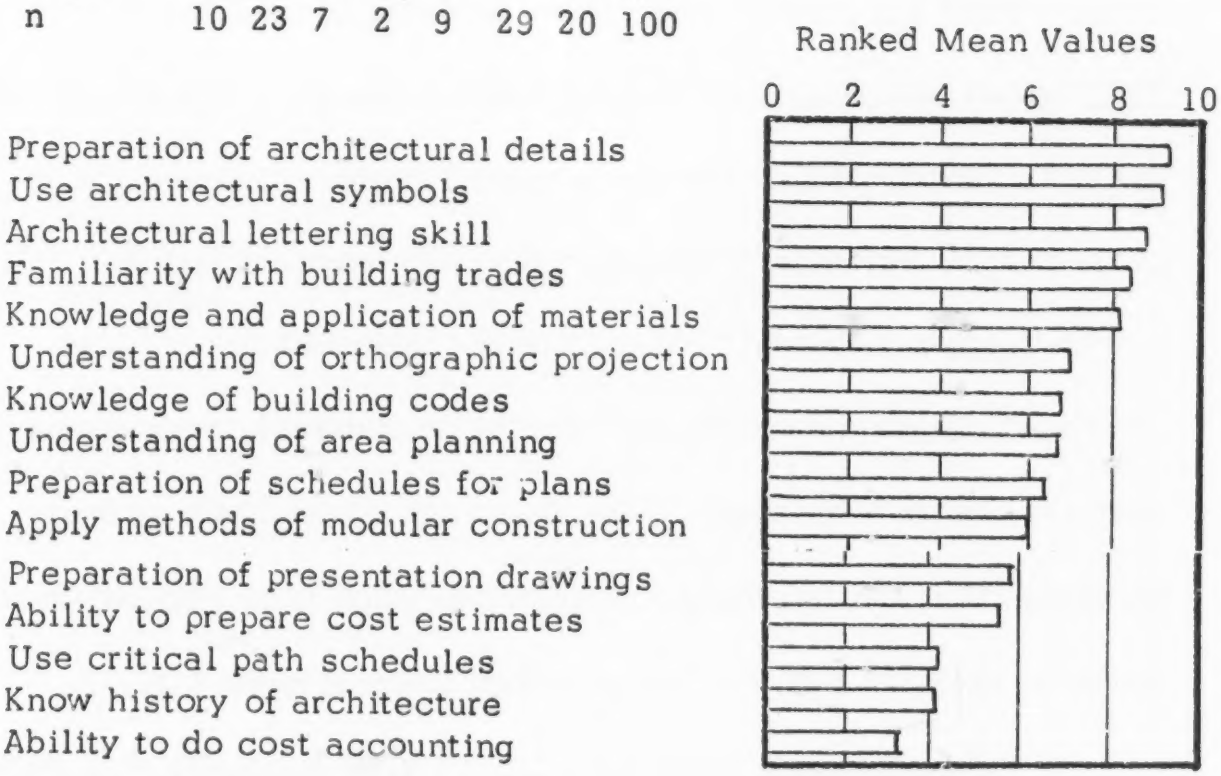


Fig. 110 --Industrial Ratings for Architectural Section

"Knowledge of elementary surveying," "Ability to lay out plats and traverses," "Preparation of plans for structures," "Detailing reinforced concrete design," "Ability to make earthwork computations," "Use of civil materials for detailing," "Use of structural properties for detailing," and "Route planning and layout" indicate these items should receive maximum instructional emphasis. The center nine rankings "Solve cut and fill problems," "Ability to detail structural steel members," "Knowledge of basic architectural drawing," "Lay out planimetric details," "Ability to prepare project estimates," "Use piping component symbols," "Legal principles and boundary control," "Detailing construction sites," and "Sizing of structural components" should receive instructional emphasis. The remaining items were rated at the point of decision (4.00 or less) and therefore should receive considerably less emphasis in classroom instruction (Figure 111).

Computer draftsman.--Statistical measurements were calculated from the responses of eleven computer draftsmen. The mean of the top ranked item, "General knowledge of drafting procedures," was 7.70. The mean of the last topic, "Use of cathode-ray tube and light pen," was 1.29. The difference between the largest and smallest measurement was 6.41. The configuration

Civil Draftsman

Region	1	2	3	4	5	6	7	N
n	8	13	4	5	5	39	12	86

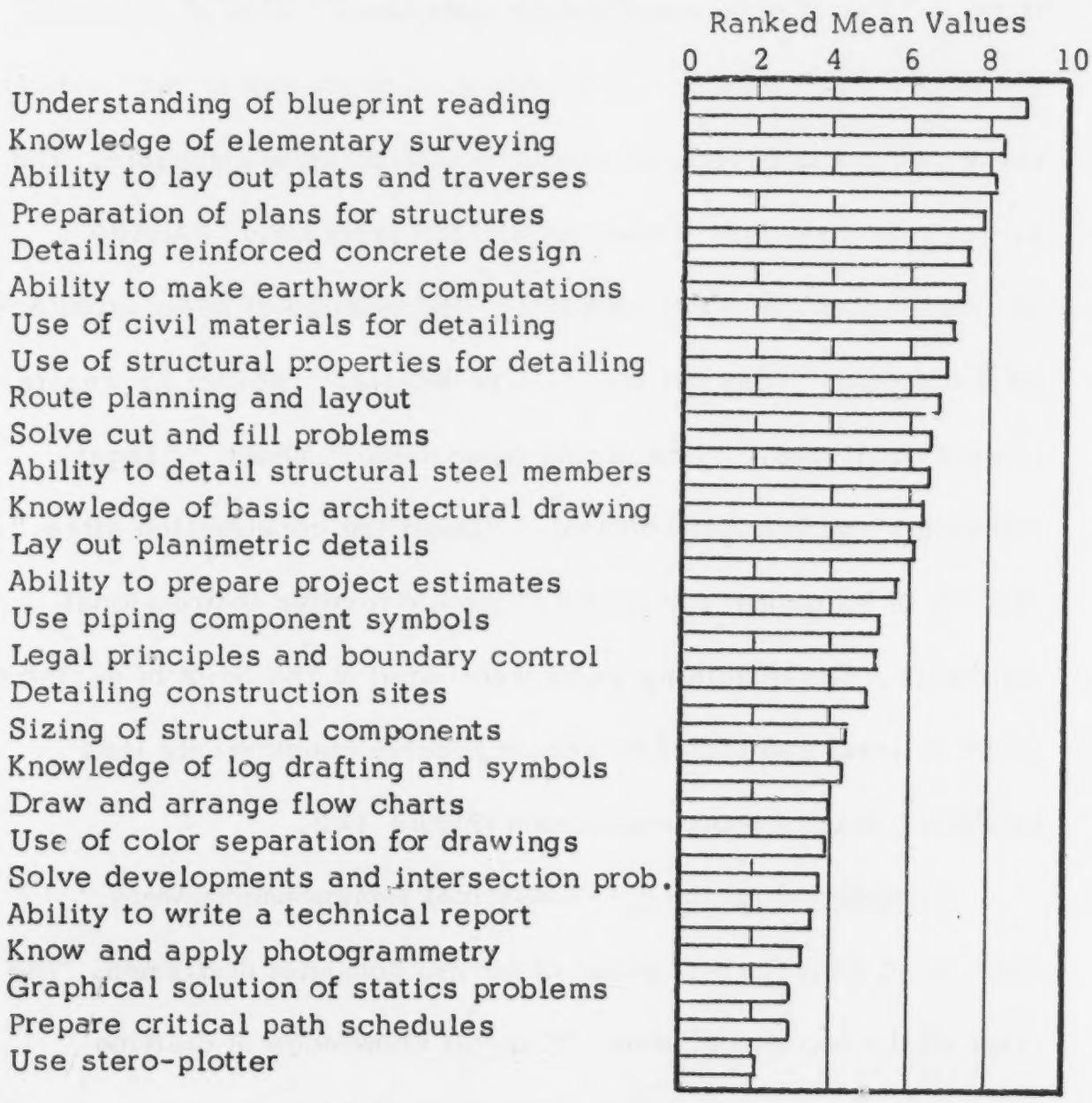

Ranked Mean Values
0
2
4
6
8
10
Understanding of blueprint reading
Knowledge of elementary surveying
Ability to lay out plats and traverses
Preparation of plans for structures
Detailing reinforced concrete design
Ability to make earthwork computations
Use of civil materials for detailing
Use of structural properties for detailing
Route planning and layout
Solve cut and fill problems
Ability to detail structural steel members
Knowledge of basic architectural drawing
Lay out planimetric details
Ability to prepare project estimates
Use piping component symbols
Legal principles and boundary control
Detailing construction sites
Sizing of structural components
Knowledge of log drafting and symbols
Draw and arrange flow charts
Use of color separation for drawings
Solve developments and intersection prob.
Ability to write a technical report
Know and apply photogrammetry
Graphical solution of statics problems
Prepare critical path schedules
Use stero-plotter

Fig. 111 --Industrial Ratings for Civil Section

of the graph was highly skewed with the majority of ratings being mean values less than 6.0. Seven of the bottom ranked topics were rated less than the cut-off value of 4.00. According to mean values, the following items should receive classroom emphasis: "General knowledge of drafting procedures," "Programming of digital computers," "Working knowledge of FORTRAN," Use of point-to-point programming," and "Understanding of machine shop practices" (Figure 112).

Electrical, electro-mechanical, and electronic draftsman.--Statistics were based on the responses of eighty-seven field specialists. Seventy-six percent (66 draftsmen) of the responses were from North Central Texas and South Texas industry. The mean of the top ranked item, "Ability to work from sketches," was 9.11. The mean value of the eleventh ranked topic, "Ability to program for computer," was 1.68. The difference between the largest and smallest measurement was 7.43. The graph indicates that instructional topics "Ability to work from sketches," "Understanding of dimensioning," " Use of electrical and electronic symbols," "Knowledge of electrical codes and standards," and "Representation of electrical system" should receive maximum emphasis, and items "Know and apply structural drawing" and "Knowledge of architectural

Computer Draftsman

Region	1	2	3	4	5	6	7	N
n	0	4	2	0	0	4	1	11

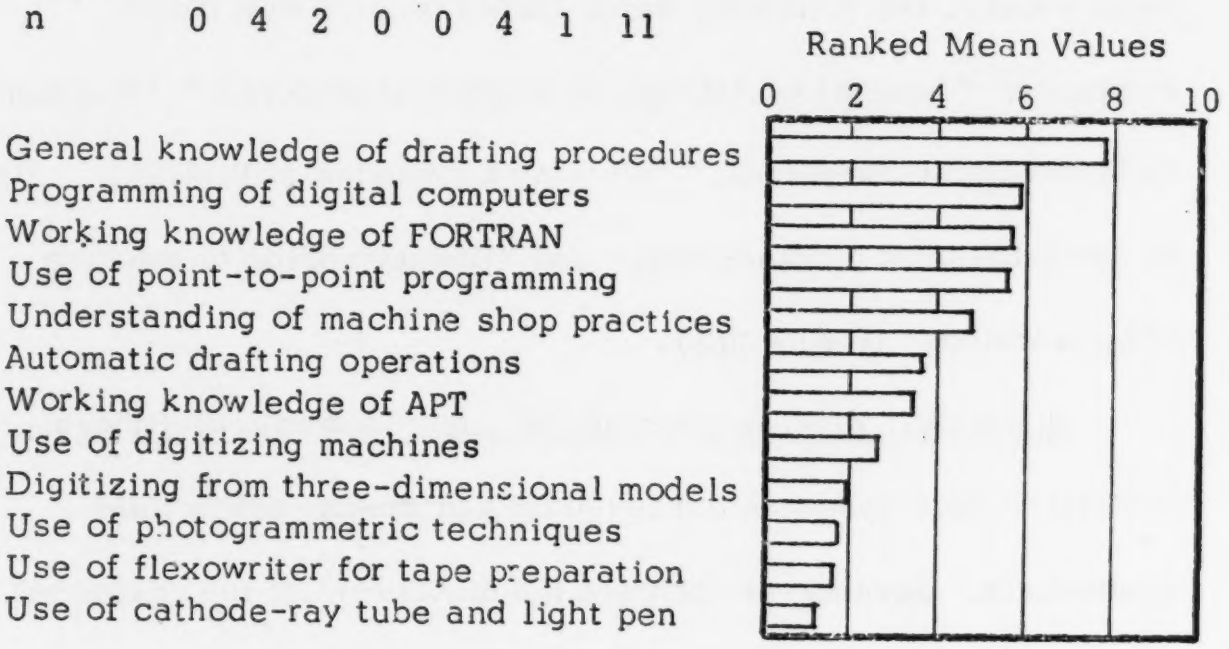


Fig. 112--Industrial Ratings for Computer Section

drawing" require a lesser degree of emphasis. The mean values of topics "Use geometric tolerances," "Requirements for microfilm reproduction," "Understanding of Electronic Theory," and "Ability to program for computer" were rated at the cut-off value and consequently should receive considerably less emphasis (Figure 113).

Foundry draftsman.--Data were compiled from the responses of eight foundry draftsmen representing East Texas, North Central Texas, and South Texas industry. The mean of the top ranking item, "Understanding of dimensioning practices," was 9.75. The rating of the last item, "Preparation of pictorials," was 2.65. The difference of mean values was 7.10. According to the graph, the first five topics "Understanding of dimensioning practices," "Prepare detail drawings," "Knowledge of shop processes/operations," and "Prepare assembly drawings" should receive maximum emphasis. The next four items "Use simplified drafting practices," "Understanding of machine practices," "General knowledge of pattern making," and "Represent threads and fasteners" should receive strong emphasis. Slightly less emphasis should be given to topics "Working knowledge of forming processes," "Representation of gears, pulleys and drives," "Understand strength of materials," and "Freehand drawing skill." Little emphasis is

Electrical, Electro-mechanical, and Electronic Draftsman

Region	1	2	3	4	5	6	7	N
n	7	26	4	3	5	40	2	87

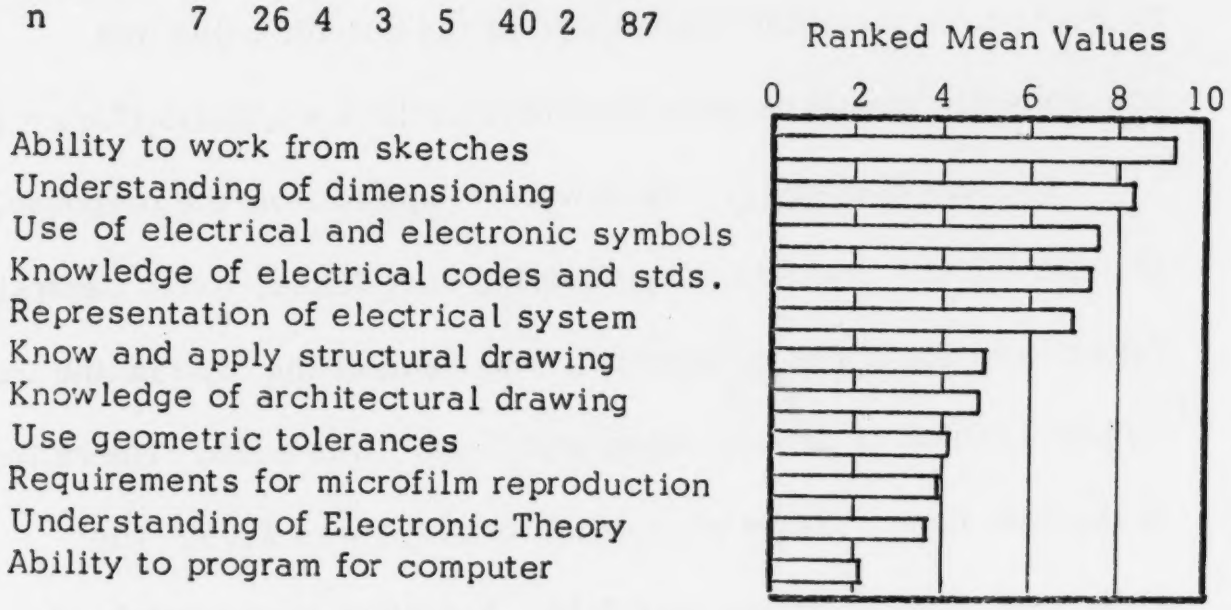


Fig. 113--Industrial Ratings for Electrical Section

necessary on the remaining topics which were evaluated at the cut-off point (Figure 114).

Map draftsman.--Statistical data were compiled from the responses of sixty-one map specialists. The mean of the highest ranking, "Ability to work from field notes," was 8.97. The lowest rating was evaluated 0.92. The difference between the largest and smallest measurement was 8.05 indicating a wide range of variability between the values of the topics. The skewness of the graph indicates a need for strong classroom emphasis on the following items: "Ability to work from field notes," "Preparation of maps and charts," "Understanding of survey practices," "Draw profiles and sections," "Use of symbols," "Layout of contours," "Use of mapping instruments," "Lay out traverses and surveys," "Prepare map revisions," and "Freehand lettering skill for maps." The means of topics "Detail site plans," "Classify information for maps," "Prepare diagrams and charts," "Use photogrammetry," and "Preparation of maps by projections" indicate these items require slightly less emphasis than the previous items. The remaining topics were rated near the cut-off value and consequently should receive considerably less emphasis (Figure 115).

Foundry Draftsman

Region	1	2	3	4	5	6	7	N
n	2	2	0	0	0	4	0	8

Understanding of dimensioning practices
Prepare detail drawings
Knowledge of shop processes/operations
Prepare assembly drawings
Use simplified drafting practices
Understanding of machine practices
General knowledge of pattern making
Represent threads and fasteners
Working knowledge of forming processes
Representation of gears, pulleys & drives
Understand strength of materials
Freehand drawing skill
Solve intersections and developments
Construct charts, graphs and nomographs
Drafting for microfilm reproduction
Preparation of pictorials

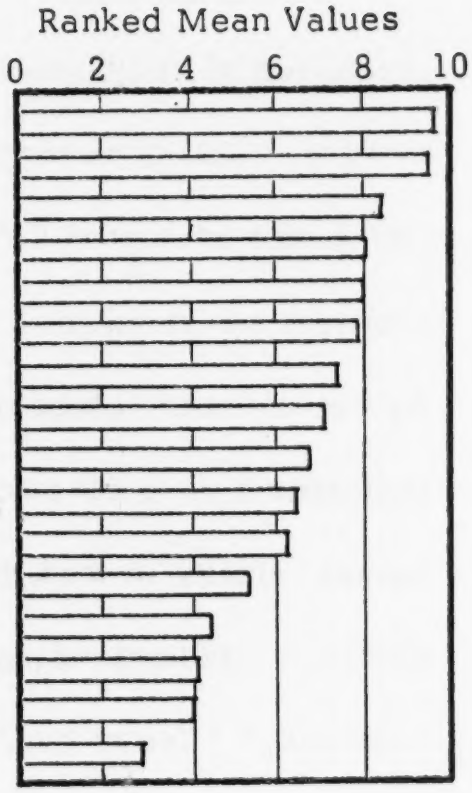
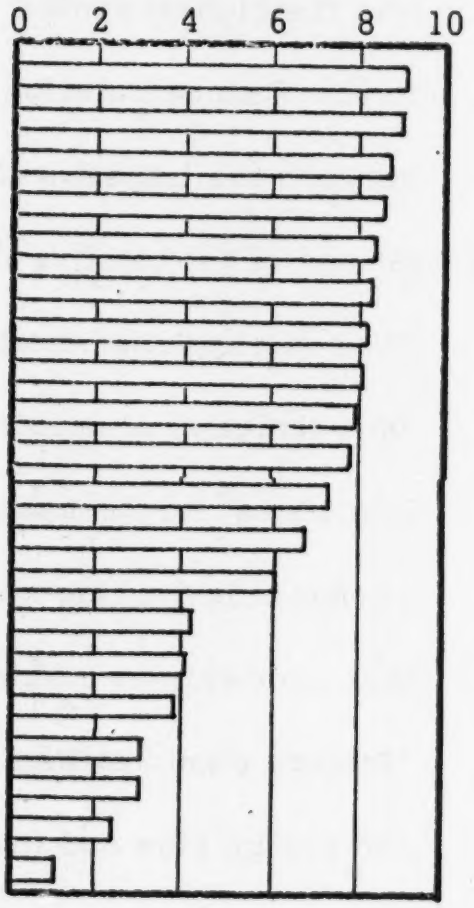


Fig. 114--Industrial Ratings for Foundry Section

Map Draftsman

Region	1	2	3	4	5	6	7	N
n	7	6	3	6	9	21	9	61

Ranked Mean Values



Ability to work from field notes
Preparation of maps and charts
Understanding of survey practices
Draw profiles and sections
Use of symbols
Layout of contours
Use of mapping instruments
Lay out traverses and surveys
Prepare map revisions
Freehand lettering skill for maps
Detail site plans
Classify information for maps
Prepare diagrams and charts
Use photogrammetry
Preparation of maps by projections
Prepare color separation for printing
Prepare subsurface maps
Use well logging symbols
Ability to use stero-plotter
Prepare mine and quarry maps

Fig. 115 --Industrial Ratings for Mapping Section

Mechanical and tool design draftsman.--Statistical measurements were calculated from 113 responses of mechanical draftsmen. Seventy-three percent (83) of the responses were from North Central Texas and South Texas industry. "Understanding of dimensioning" was the highest ranked item with a mean of 9.24. The lowest rated item, "Cam calculation and design," was rated 2.83. The difference between the largest and smallest measurement was 6.41. The ratings of the top five items "Understanding of dimensioning," "Use of simplified drafting practices," "Use of welding symbols," "Knowledge of elements of machine design," and "Use geometric tolerances" suggest that these items should receive maximum emphasis in drafting classes. The following twelve items require less emphasis in instruction: "Knowledge of structural drawing," "Prepare pipe drawings," "Preparation of casting drawings," "Draw and design jigs and fixtures," "Knowledge of gage design fundamentals," "Drafting for microfilm reproduction," "Apply elementary electrical principles," "Know electrical-electronics drafting," "Knowledge of tool inspection procedures," "Knowledge of cutting tool design," "Specify manufacturing processes," and "Knowledge of punch and die design." The remaining items are rated near the point of decision (4.00) and consequently little emphasis should be

devoted to them (Figure 116).

Piping draftsman.--Statistical measurements were derived from the responses of fifty-nine piping draftsmen. Fifty-four percent (32) of the responses were from South Texas industry. The highest mean was 9.17 as compared with the lowest value of 2.71. The difference between these measurements was 6.46. The configuration of the graph indicates that maximum classroom emphasis should be devoted to: "Use of piping components and symbols," "Apply dimensioning practices," "Use of piping specifications and materials," "Use of simplified drafting practices," "Understanding of orthographic projection," "Calculate and lay out pipe grades," and "Knowledge of mechanical equipment." The following topics should receive instructional emphasis: "Representation of vessels," "Lay out equipment arrangements," "Prepare cost and quantity estimates," "Use Smoley's Trigonometry Handbook," "Understanding of basic instrumentation," "Preparation of drawings," and "Ability for basic structural detailing." The remaining topics were rated near the cut-off and require less emphasis (Figure 117).

Sheet metal draftsman.--Statistical measurements were based on thirty-five responses of sheet metal draftsmen. Seventy-four

Mechanical and Tool Design Draftsman

Region	1	2	3	4	5	6	7	N
n	10	33	8	6	3	50	3	113

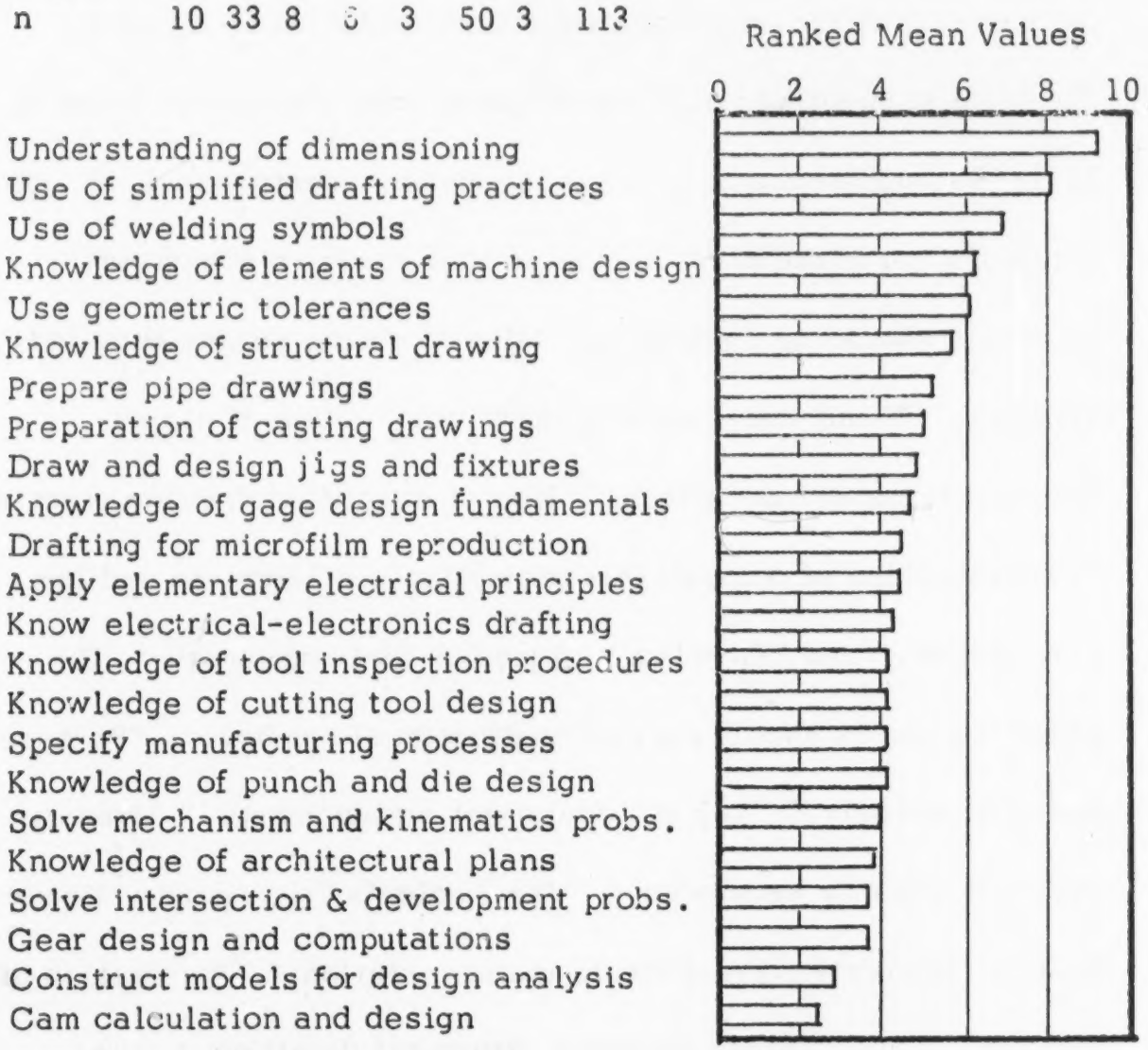


Fig. 116--Industrial Ratings for Mechanical and Tool Design Section

Piping Draftsman

Region	1	2	3	4	5	6	7	N
n	4	7	1	6	5	32	4	59

Use of piping components and symbols
Apply dimensioning practices
Use of piping specifications & materials
Use of simplified drafting practices
Understanding of orthographic projection
Calculate and lay out pipe grades
Knowledge of mechanical equipment
Representation of vessels
Lay out equipment arrangements
Prepare cost and quantity estimates
Use Smoley's Trig. Handbook
Understanding of basic instrumentation
Preparation of drawings
Ability for basic structural detailing
Specify structural components
Preparation of nomographs
Prepare architectural plans
Drafting for microfilm reproduction
Understanding of basic electrical design
Drafting of civil structures
Program for computer
Construct models

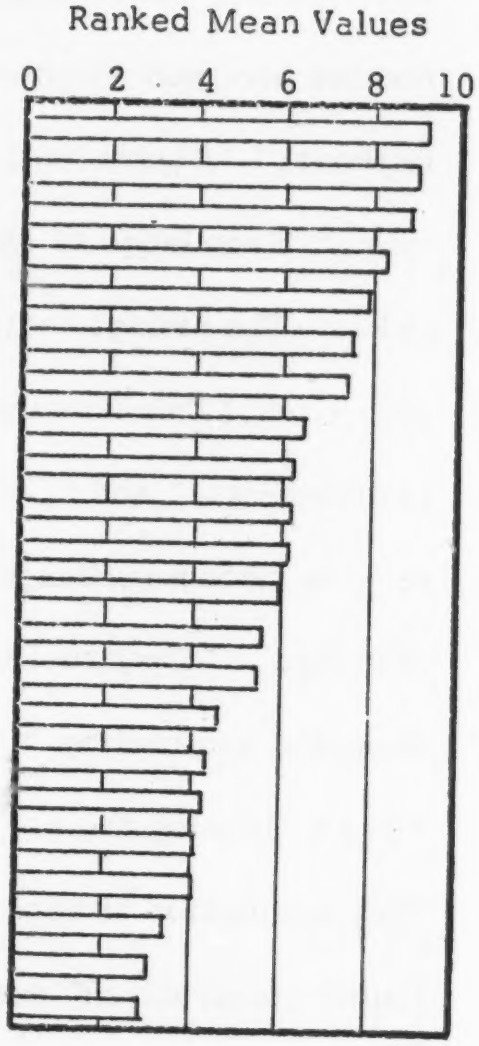


Fig. 117--Industrial Ratings for Piping Section

percent (26) of the responses were from North Central Texas and South Texas industry. The highest mean was 8.88 as compared with the lowest rating, 3.86. The difference between the largest and smallest measurement was 5.02. The following topics should receive maximum emphasis: "Knowledge of general drafting methods," "Dimension layouts," "Ability to make freehand drawings," "Knowledge of sheeting materials," and "Knowledge of bend radii." The ratings indicate items "Knowledge of forming processes," "Utilization of templates," "Knowledge of edge-margin requirements," and "Constructions of auxiliary views" should receive strong emphasis. Topics "Preparation of duct work drawings," "Construction of true length diagrams," "Knowledge of stamping and tooling," "Representation of clips and connectors," "Use of forming tables," "Solving developments and intersections," "Representation of seams and locks," and "Prepare designs for louver construction" need some emphasis in instruction (Figure 118).

Structural draftsman.--Descriptive statistics were derived from 115 responses by structural draftsmen. Sixty-one percent (70) of the responses were from North Central Texas and South Texas industry. The top rating was 9.15 as compared with a low of 2.40. The difference between the largest and smallest measurement was

Sheet Metal Draftsman

Region	1	2	3	4	5	6	7	N
n	3	13	2	0	0	13	4	35

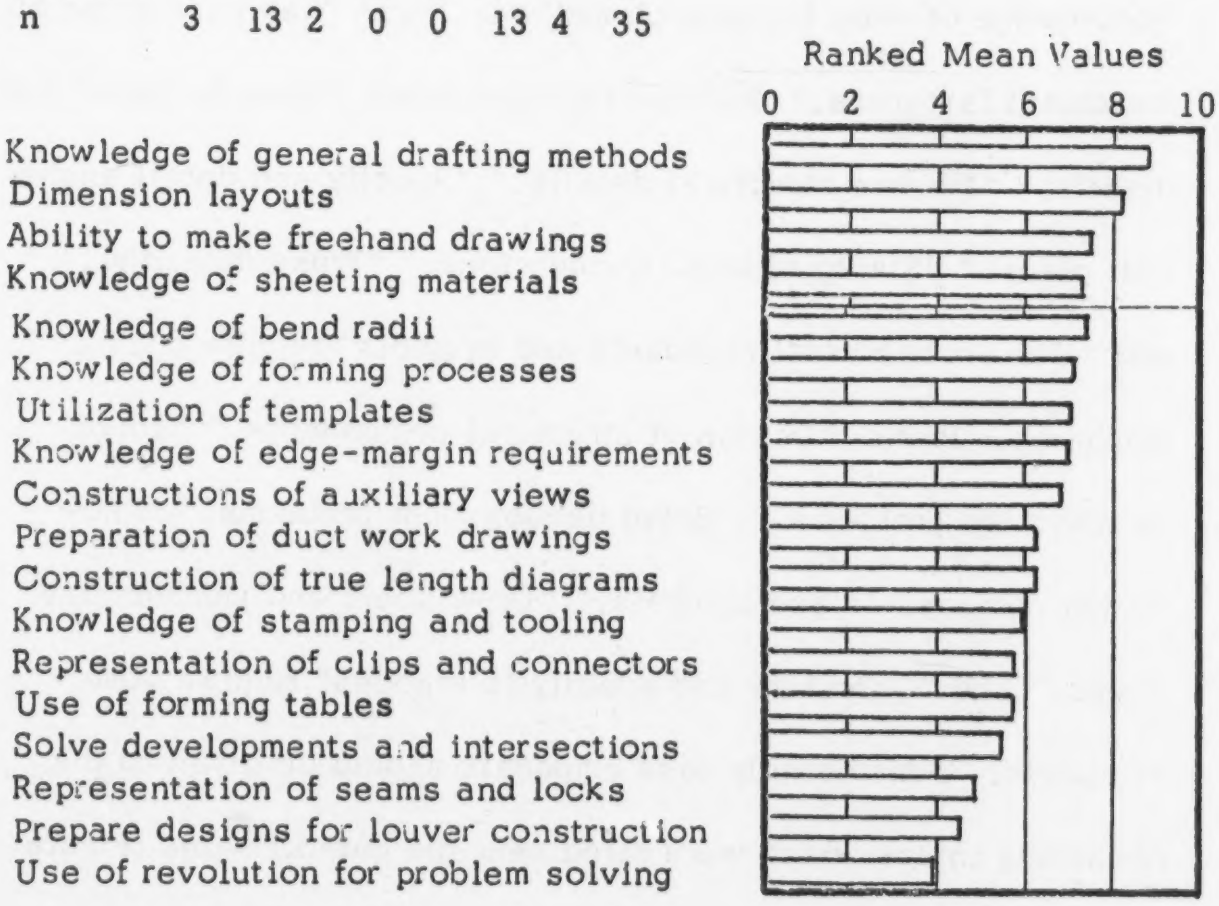


Fig. 118--Industrial Ratings for Sheet Metal Section

6.75. Data indicates maximum emphasis should be given to topics "Knowledge of structural steel members," "Use of standards and recommended practices," "Use simplified drafting practices," "Knowledge of shop fabrication methods," and "Representation of structural fasteners." Ratings indicate items "Specify foundation details," "Prepare structural details," "Specify and detail anchor bolt plans," "Sizing of beam connections," "Truss detailing," and "Use architectural standards and symbols" require strong emphasis. Items "Design of structural components," "Solve intersection problems," "Solve development problems," "Know piping components and symbols," "Draw shear and moment diagrams," and "Calculate and specify tolerances" require some emphasis. Considerably less emphasis should be given to the remaining topics which were rated near the cut-off value (Figure 119).

Technical illustration draftsman.--Statistical measurements were compiled from the responses of forty-five technical illustrators. Seventy-one percent (32) of the responses were from North Central Texas and South Texas industry. The top mean was 8.94, and the lowest value was 2.86. The difference between the largest and smallest measurement was 6.08. The industrial evaluations indicate maximum emphasis for items "Use of time saving devices,"

Structural Draftsman

Region	1	2	3	4	5	6	7	N
n	8	21	8	10	7	49	12	115

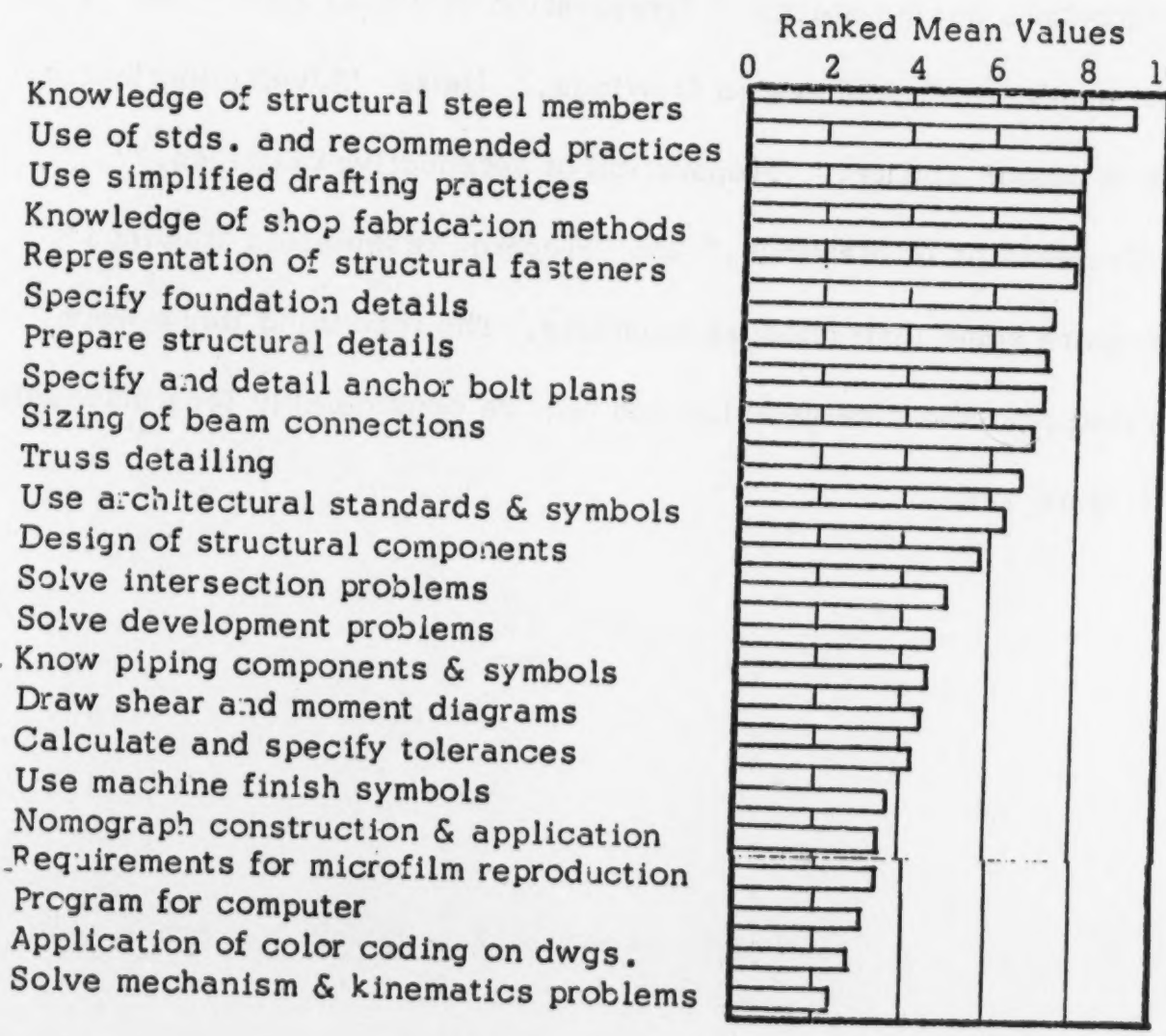


Fig. 119--Industrial Ratings for Structural Section

"Freehand technical sketching skill," "Ability to illustrate technical reports," and "Understanding of multiview projection." Strong emphasis should be given topics "Knowledge of art and design principles," "Application of photoprinting methods," "Brochure design ability," "Preparation of visual aids," and "Use of shades and shadows on drawings." Items "Advertising layout and design ability," "Preparation of perspective drawings," "Preparation of drawings," and "Prepare presentation drawings" require some instructional emphasis. The remaining items were rated near the cut-off value and require considerably less emphasis (Figure 120).

Technical Illustration Draftsman

Region	1	2	3	4	5	6	7	N
n	4	16	4	1	3	16	1	45

Use of time saving devices
Freehand technical sketching skill
Ability to illustrate technical reports
Understanding of multiview projection
Knowledge of art & design principles
Application of photoprinting methods
Brochure design ability
Preparation of visual aids
Use of shades & shadows on drawings
Advertising layout & design ability
Preparation of perspective drawings
Preparation of drawings
Prepare presentation drawings
Knowledge of machine design
Application of silkscreening
Knowledge of mechanisms & kinematics
Ability to write a technical report
Use doubletone (Craftint)

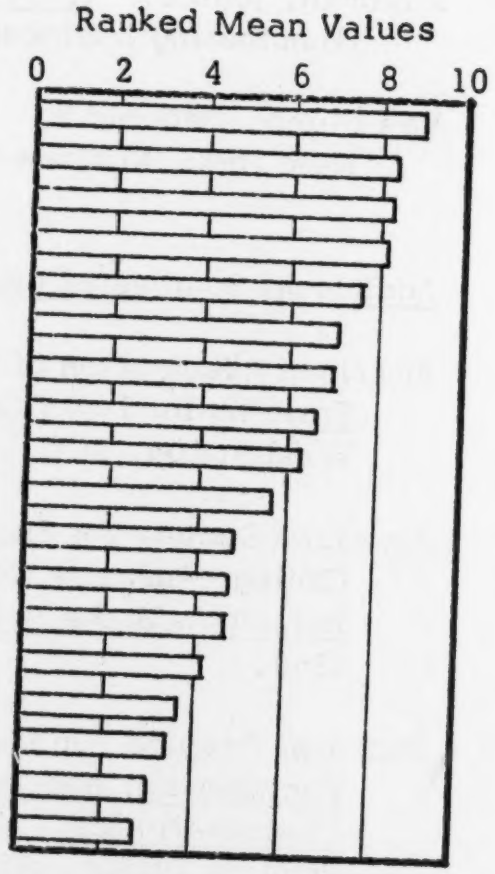


Fig. 120--Industrial Ratings for Technical Illustration Section

BIBLIOGRAPHY

References Cited:

Ferguson, George A. Statistical Analysis in Psychology and Education. New York: McGraw-Hill Book Company, Inc., 1969.

Kaufman, John E. I.E.S. Lighting Handbook, 4th Ed. New York: Illuminating Engineering Society, 1966.

Van Dalen, Deobold B. Understanding Educational Research. New York: McGraw-Hill Book Company, Inc., 1966.

Additional Sources of Information:

American Association of Junior Colleges. 1969 Guide to In-Service Training for Two Year College Faculty and Staff Members. Washington, D.C., 1969.

American Society for Engineering Education, Report of the 1969 College-Industry Conference, David A. Day, Chairman. Industry's Stake in the Changing Curriculum. Washington, D.C. 1969.

National Science Foundation. Junior College Teachers of Science, Engineering, and Technology, 1967--Experience and Employment Characteristics, NSF69-3. Washington, D.C.: Government Printing Office, 1968.

U.S. Department of Health, Education, and Welfare. Criteria for Technical Education--A Suggested Guide, OE-80056. Washington, D.C.: Government Printing Office, 1968.

U.S . Department of Health, Education, and Welfare. Procedures for the Establishment of Public 2-Year Colleges, OE-57006, Bulletin 1966, No. 14. Washington, D.C.: Government Printing Office, 1966.

U.S. Department of Labor. Manpower Report of the President. Washington, D.C.: Government Printing Office, 1969.